E 9

```
LLL              BBBBBBBBBBBB     RRRRRRRRRRRR
LLL              BBBBBBBBBBBB     RRRRRRRRRRRR
LLL              BBBBBBBBBBBB     RRRRRRRRRRRR
LLL              BBB         BBB  RRR         RRR
LLL              BBB         BBB  RRR         RRR
LLL              BBB         BBB  RRR         RRR
LLL              BBB         BBB  RRR         RRR
LLL              BBB         BBB  RRR         RRR
LLL              BBB         BBB  RRR         RRR
LLL              BBBBBBBBBBBB     RRRRRRRRRRRR
LLL              BBBBBBBBBBBB     RRRRRRRRRRRR
LLL              BBBBBBBBBBBB     RRRRRRRRRRRR
LLL              BBB         BBB  RRR   RRR
LLL              BBB         BBB  RRR   RRR
LLL              BBB         BBB  RRR   RRR
LLL              BBB         BBB  RRR      RRR
LLL              BBB         BBB  RRR      RRR
LLL              BBB         BBB  RRR      RRR
LLLLLLLLLLLLLLL  BBBBBBBBBBBB     RRR         RRR
LLLLLLLLLLLLLLL  BBBBBBBBBBBB     RRR         RRR
LLLLLLLLLLLLLLL  BBBBBBBBBBBB     RRR         RRR
```

```
_$2

Val
---
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
002
00F
00F
00F
00F
00F
00F
00F
7FF
7FF
7FF
7FF
7FF
7FF
7FF
7FF
```

```
                                                                 D 15
**FILE**ID**INDEX




            IIIIII    NN      NN  DDDDDDDD    EEEEEEEEEE  XX      XX
            IIIIII    NN      NN  DDDDDDDD    EEEEEEEEEE  XX      XX
              II      NN      NN  DD      DD  EE          XX      XX
              II      NN      NN  DD      DD  EE          XX      XX
              II      NNNN    NN  DD      DD  EE            XX  XX
              II      NNNN    NN  DD      DD  EE            XX  XX
              II      NN  NN  NN  DD      DD  EEEEEEEE        XX
              II      NN  NN  NN  DD      DD  EEEEEEEE        XX
              II      NN    NNNN  DD      DD  EE            XX  XX
              II      NN    NNNN  DD      DD  EE            XX  XX
              II      NN      NN  DD      DD  EE          XX      XX      ....
              II      NN      NN  DD      DD  EE          XX      XX      ....
            IIIIII    NN      NN  DDDDDDDD    EEEEEEEEEE  XX      XX      ....
            IIIIII    NN      NN  DDDDDDDD    EEEEEEEEEE  XX      XX      ....

          LL            IIIIII      SSSSSSSS
          LL            IIIIII      SSSSSSSS
          LL              II      SS
          LL              II      SS
          LL              II      SS
          LL              II      SS
          LL              II        SSSSSS
          LL              II        SSSSSS
          LL              II              SS
          LL              II              SS
          LL              II              SS
          LL              II              SS
          LLLLLLLLLL    IIIIII    SSSSSSSS
          LLLLLLLLLL    IIIIII    SSSSSSSS
```

```
0 MODULE LBR_INDEX
0                (IDENT = 'V04-000') =    ! Index manipulation routines
1 BEGIN
1
1 !
1 !****************************************************************************
1 !*                                                                          *
1 !*  COPYRIGHT (c) 1978, 1980, 1982, 1984 BY                                 *
1 !*  DIGITAL EQUIPMENT CORPORATION, MAYNARD, MASSACHUSETTS.                  *
1 !*  ALL RIGHTS RESERVED.                                                    *
1 !*                                                                          *
1 !*  THIS SOFTWARE IS FURNISHED UNDER A LICENSE AND MAY BE USED AND COPIED   *
1 !*  ONLY IN  ACCORDANCE WITH  THE  TERMS  OF  SUCH  LICENSE  AND WITH THE   *
1 !*  INCLUSION OF THE ABOVE COPYRIGHT NOTICE. THIS SOFTWARE OR  ANY  OTHER   *
1 !*  COPIES THEREOF MAY NOT BE PROVIDED OR OTHERWISE MADE AVAILABLE TO ANY   *
1 !*  OTHER PERSON.  NO TITLE TO AND OWNERSHIP OF  THE  SOFTWARE IS  HEREBY   *
1 !*  TRANSFERRED.                                                            *
1 !*                                                                          *
1 !*  THE INFORMATION IN THIS SOFTWARE IS  SUBJECT TO CHANGE WITHOUT NOTICE   *
1 !*  AND  SHOULD  NOT  BE  CONSTRUED AS  A COMMITMENT BY DIGITAL EQUIPMENT   *
1 !*  CORPORATION.                                                            *
1 !*                                                                          *
1 !*  DIGITAL ASSUMES NO RESPONSIBILITY FOR THE USE  OR  RELIABILITY OF ITS   *
1 !*  SOFTWARE ON EQUIPMENT WHICH IS NOT SUPPLIED BY DIGITAL.                 *
1 !*                                                                          *
1 !*                                                                          *
1 !****************************************************************************
1
1 !++
1 !
1 ! FACILITY:  Library access procedures
1 !
1 ! ABSTRACT:
1 !
1 !       The VAX/VMS librarian procedures implement a standard access method
1 !       to libraries through a shared, common procedure set.
1 !
1 ! ENVIRONMENT:
1 !
1 !       VAX native, user mode.
1 !
1 !--
1 !
1 !
1 ! AUTHOR: Tim Halvorsen, Benn Schreiber          11-Jun-1979
1 !
1 ! MODIFIED BY:
1 !
1 !       V03-004 GJA0078         Greg Awdziewicz         22-Mar-1984
1 !               Put traverse_keys fix back in.
1 !
1 !       V03-003 JWT0093         Jim Teague              01-Feb-1983
1 !               Undo last fix.
1 !
1 !       V03-002 JWT0091         Jim Teague              20-Jan-1983
1 !               Propagate status returned from traverse or traverse2.
1 !
```

```
:   58          0058  1 !        V03-001 JWT0058         Jim Teague              19-Oct-1982
:   59          0059  1 !                Fix variable-length index module deletion bug.
:   60          0060  1 !
:   61          0061  1 !--
```

```
;    63        0062  1 %SBTTL 'Declarations';
;    64        0063  1 LIBRARY 'SYS$LIBRARY:STARLET.L32';        ! VAX/VMS common definitions
;    65        0064  1
;    66        0065  1 REQUIRE 'PREFIX';                    ! Librarian general definitions
;    67        0204  1
;    68        0205  1 REQUIRE 'LBRDEF';                    ! Librarian structure definitions
;    69        0796  1
;    70        0797  1 REQUIRE 'OLDFMTDEF';                 ! Old library format definitions
;    71        0893  1
;    72        0894  1 LINKAGE
;    73        0895  1     fmg_match = JSB (REGISTER = 2, REGISTER = 3,
;    74        0896  1                      REGISTER = 4, REGISTER = 5) : NOTUSED (10, 11); ! Linkage for FMG$MATCH_NAME
;    75        0897  1
;    76        0898  1 FORWARD ROUTINE
;    77        0899  1     lbr$set_index,                   ! Set current index number
;    78        0900  1     lbr$lookup_key,                  ! Lookup a key and return RFA
;    79        0901  1     lbr$insert_key,                  ! Insert a key
;    80        0902  1     lbr$replace_key,                 ! Replace rfa for key and modify module header ref. counts
;    81        0903  1     lbr$delete_key,                  ! Delete a key
;    82        0904  1     lbr$get_index,                   ! Return all entries of an index
;    83        0905  1     lbr$search,                      ! Search for all keys assoc. with RFA
;    84        0906  1     check_wild,                      ! Check wildcard name against entry
;    85        0907  1     call_user,                       ! Call user action routine
;    86        0908  1     add_key,                         ! Add a key to a specified index
;    87        0909  1     delete_key,                      ! Delete key from current primary index
;    88        0910  1     remove_key,                      ! Remove a key from a specified index
;    89        0911  1     lookup_key,                      ! Lookup a key and return an RFA
;    90        0912  1     traverse_keys,                   ! Traverse an index one key at a time
;    91        0913  1     create_index,                    ! Create an index block
;    92        0914  1     delete_index,                    ! Deallocate an index block
;    93        0915  1     find_key,                        ! Find key in index structure
;    94        0916  1     key_search,                      ! Binary key search
;    95        0917  1     key_search2,                     ! Variable length keyword search
;    96        0918  1     find_index : JSB_2,              ! Locate index block
;    97        0919  1     add_index,                       ! Add index pointer to parent block
;    98        0920  1     add_index2,                      ! Add index pointer to parent block of variable index
;    99        0921  1     reset_highest,                   ! Reset highest keys in parent blocks
;   100        0922  1     reset_highest2,                  ! Reset highest keys in variable len index
;   101        0923  1                                      !   parent blocks
;   102        0924  1     check_lock : JSB_0,              ! Check if index is locked from modification
;   103        0925  1     mark_dirty : JSB_1;              ! Mark index block modified
;   104        0926  1
;   105        0927  1 EXTERNAL ROUTINE
;   106        0928  1     fmg$match_name : fmg_match,      ! Perform embedded wild-card matching
;   107        0929  1     make_upper_case : JSB_3,         ! Convert name to upper case, check length
;   108        0930  1     moveto_upper_case : JSB_3,       ! Convert
;   109        0931  1     incr_refcnt,                     ! Increment module reference count
;   110        0932  1     decr_refcnt,                     ! Decrement module reference count
;   111        0933  1     lbr_old_lkp_key,                 ! Lookup key in old library
;   112        0934  1     lbr_old_get_idx,                 ! Return contents of old library index
;   113        0935  1     lbr_old_src_idx,                 ! Search old library index for RFA
;   114        0936  1     read_old_record : JSB_2,         ! Read record from old format library
;   115        0937  1     get_mem : JSB_2,                 ! Allocate dynamic memory
;   116        0938  1     get_zmem : JSB_2,                ! Allocate zeroed dynamic memory
;   117        0939  1     dealloc_mem : JSB_2,             ! Deallocate dynamic memory
;   118        0940  1     alloc_block : JSB_2,             ! Allocate disk block
;   119        0941  1     dealloc_block : JSB_1,           ! Deallocate disk block
;  120         0942  1        read_block : JSB_2,          ! Read disk block
;  121         0943  1        read_n_block : JSB_2,        ! Read and cache multiple disk blocks
;  122         0944  1        find_block : JSB_3,          ! Locate disk block and cache it
;  123         0945  1        read_record : JSB_2,         ! Read data record
;  124         0946  1        write_record,                ! Write data record
;  125         0947  1        add_cache : JSB_2,           ! Add cache entry
;  126         0948  1        lookup_cache : JSB_2,        ! Lookup cache entry
;  127         0949  1        empty_cache,                 ! Empty cache - write all dirty blocks
;  128         0950  1        set_module,                  ! Read module header
;  129         0951  1        incr_rfa : JSB_2,            ! Increment an RFA
;  130         0952  1        validate_ctl : JSB_1;        ! Validate control table index
;  131         0953  1
;  132         0954  1  EXTERNAL
;  133         0955  1        lbr$gl_maxread,              ! Max number of blocks to read at once
;  134         0956  1        lbr$gl_maxidxrd,             ! Max number of blocks in one index read
;  135         0957  1        lbr$gl_control: REF BBLOCK;  ! Address of control block
;  136         0958  1
;  137         0959  1  EXTERNAL LITERAL
;  138         0960  1        lbr$_dupkey,
;  139         0961  1        lbr$_illctl,
;  140         0962  1        lbr$_illidxnum,
;  141         0963  1        lbr$_illop,
;  142         0964  1        lbr$_intrnlerr,
;  143         0965  1        lbr$_invkey,
;  144         0966  1        lbr$_invrfa,
;  145         0967  1        lbr$_keynotfnd,
;  146         0968  1        lbr$_libnotopn,
;  147         0969  1        lbr$_nomtchfou,
;  148         0970  1        lbr$_nulidx,
;  149         0971  1        lbr$_updurtrav;
;  150         0972  1
;  151         0973  1
```

```
1 %SBTTL  'LBR$SET_INDEX';
1 GLOBAL ROUTINE lbr$set_index (ctl_index, index) =
1
1 !---
1 !
1 !       Set the current primary index for later operations.
1 !
1 ! Inputs:
1 !
1 !       ctl_index = Address of longword containing control table index.
1 !       index = Primary index number
1 !
1 ! Outputs:
1 !
1 !       lbr$_illidxnum - illegal index number
1 !       lbr$_libnotopn - library file not open
1 !       lbr$_insvirmem - insufficent virtual memory
1 !       lbr$_illctl - illegal control table index
1 !---
1
2 BEGIN
2
2 BUILTIN
2     NULLPARAMETER;                  ! True if argument unspecified
2
2
2 perform (validate_ctl (..ctl_index));   ! Validate control table index
2
3 BEGIN
3     BIND
3         header = .lbr$gl_control [lbr$l_hdrptr]: BBLOCK; ! Get address of library header
3
3     IF NULLPARAMETER(2)                           ! If index number not supplied
3     OR ..index GTRU .header [lhd$b_nindex]        ! If greater than maximum,
3     OR ..index EQL 0
3     THEN
3         RETURN lbr$_illidxnum;           ! return with error
3
3     lbr$gl_control [lbr$l_curidx] = ..index; ! Save current index number
2     END;
2
2 RETURN true;
2
1 END;


                                                        .TITLE  LBR_INDEX
                                                        .IDENT  \V04-000\

                                                        .EXTRN  FMG$MATCH_NAME, MAKE_UPPER_CASE
                                                        .EXTRN  MOVETO_UPPER_CASE
                                                        .EXTRN  INCR_REFCNT, DECR_REFCNT
                                                        .EXTRN  LBR_OLD_LKP_KEY
                                                        .EXTRN  LBR_OLD_GET_IDX
                                                        .EXTRN  LBR_OLD_SRC_IDX
                                                        .EXTRN  READ_OLD_RECORD
                                                        .EXTRN  GET_MEM, GET_ZMEM
```

```
                                                                .EXTRN  DEALLOC_MEM, ALLOC_BLOCK
                                                                .EXTRN  DEALLOC_BLOCK, READ_BLOCK
                                                                .EXTRN  READ_N_BLOCK, FIND_BLOCK
                                                                .EXTRN  READ_RECORD, WRITE_RECORD
                                                                .EXTRN  ADD_CACHE, LOOKUP_CACHE
                                                                .EXTRN  EMPTY_CACHE, SET_MODULE
                                                                .EXTRN  INCR_RFA, VALIDATE_CTL
                                                                .EXTRN  LBR$GL_MAXREAD, LBR$GL_MAXIDXRD
                                                                .EXTRN  LBR$GL_CONTROL, LBR$_DUPKEY
                                                                .EXTRN  LBR$_ILLCTL, LBR$_ILLIDXNUM
                                                                .EXTRN  LBR$_ILLOP, LBR$_INTRNLERR
                                                                .EXTRN  LBR$_INVKEY, LBR$_INVRFA
                                                                .EXTRN  LBR$_KEYNOTFND, LBR$_LIBNOTOPN
                                                                .EXTRN  LBR$_NOMTCHFOU, LBR$_NULIDX
                                                                .EXTRN  LBR$_UPDURTRAV

                                                                .PSECT  $CODE$,NOWRT,2

                                              0FFC 00000        .ENTRY  LBR$SET_INDEX, Save R2,R3,R4,R5,R6,R7,R8,-      ; 0975
                                                                        R9,R10,R11                                      ;
                           50        04    BC  D0 00002         MOVL    @CTL_INDEX, R0                                  ; 1000
                                       0000G   30 00006         BSBW    VALIDATE_CTL                                    ;
                           31          50      E9 00009         BLBC    STATUS, 3$                                      ;
                           51       0000G  CF  D0 0000C         MOVL    LBR$GL_CONTROL, R1                              ; 1004
                           50        0A    A1  D0 00011         MOVL    10(R1), R0                                      ;
                           02              6C  91 00015         CMPB    (AP), #2                                        ; 1006
                                           13  1F 00018         BLSSU   1$                                              ;
                                     08    AC  D5 0001A         TSTL    8(AP)                                           ;
                                           0E  13 0001D         BEQL    1$                                              ;
   08   BC     01   A0     08              00  ED 0001F         CMPZV   #0, #8, 1(R0), @INDEX                           ; 1007
                                           05  1F 00026         BLSSU   1$                                              ;
                                     08    BC  D5 00028         TSTL    @INDEX                                          ; 1008
                                           08  12 0002B         BNEQ    2$                                              ;
                           50 00000000G    8F  D0 0002D 1$:     MOVL    #LBR$_ILLIDXNUM, R0                             ; 1010
                                               04 00034         RET                                                     ;
                      12   A1        08    BC  D0 00035 2$:     MOVL    @INDEX, 18(R1)                                  ; 1012
                           50              01  D0 0003A         MOVL    #1, R0                                          ; 1015
                                               04 0003D 3$:     RET                                                     ; 1017

; Routine Size:  62 bytes,    Routine Base:  $CODE$ + 0000
```

```
1 %SBTTL  'LBR$LOOKUP_KEY';
1 GLOBAL ROUTINE lbr$lookup_key (ctl_index, key_name, retrfa) =
1
1 !---
1 !
1 !       Lookup a specified key and return the RFA associated
1 !       with the key.
1 !
1 ! Inputs:
1 !
1 !       ctl_index = Address of a longword containing control table index.
1 !       key_name = Address of descriptor if ASCII keys,
1 !                       or actual binary key.
1 !       retrfa = Address of 6-byte buffer to receive RFA.
1 !
1 ! Outputs:
1 !
1 !       retrfa = RFA associated with key, if found.
1 !
1 !       lbr$_libnotopn - library not open
1 !       lbr$_keynotfnd - key not found
1 !       lbr$_illctl - illegal control table index
1 !
1 !---
1
2 BEGIN
2
2 MAP
2     key_name : REF BBLOCK,                ! Pointer to string descriptor
2     retrfa: REF BBLOCK;                   ! Pointer to RFA
2
2 LOCAL
2     keydesc : BBLOCK [dsc$c_s_bln],
2     keynambuf : BBLOCK [lbr$c_maxkeylen],
2     recdesc : BBLOCK [dsc$c_s_bln];
2
2 BIND
2     length = recdesc [dsc$w_length] : WORD,
2     addr = recdesc [dsc$a_pointer] : REF BBLOCK;
2
2 perform (validate_ctl (..ctl_index));   ! Validate control table index
2 keydesc [dsc$w_length] = .key_name [dsc$w_length];! Set length of name
2 keydesc [dsc$a_pointer] = keynambuf;
2 CH$MOVE (.key_name [dsc$w_length],
2         .key_name [dsc$a_pointer], .keydesc [dsc$a_pointer]);
2
3 BEGIN
3     BIND
3         header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK, ! Pointer to header
3         context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK, ! Pointer to context block
3         eomodrfa = context[ctx$b_eomodrfa] : BBLOCK,    ! End of module RFA
3         readrfa = context[ctx$b_readrfa] : BBLOCK;      ! Next RFA for read
3
3     IF .context[ctx$v_oldlib]                          ! If old format library
3     THEN
4         BEGIN
4             perform(lbr_old_lkp_key (keydesc, .retrfa));! Then process elsewhere
```

```
;  255          1075  4                 CH$MOVE(rfa$c_length, .retrfa, readrfa);    ! Set RFA for reading
;  256          1076  4                 CH$FILL(0, rfa$c_length, eomodrfa);         ! Disable end of module
;  257          1077  4                 perform(read_old_record(readrfa, recdesc)); ! Read and skip header
;  258          1078  4                 IF .length NEQ omh$c_size
;  259          1079  4                     THEN RETURN lbr$_invrfa
;  260          1080  4                     ELSE
;  261          1081  5                         BEGIN
;  262          1082  5                             BIND
;  263          1083  5                                 modsizwords = addr[omh$l_modsiz] : VECTOR[,WORD];
;  264          1084  5
;  265          1085  5                             CH$MOVE(rfa$c_length, .retrfa, eomodrfa);
;  266          1086  5                             incr_rfa(.modsizwords[1] + .modsizwords[0]*%X'10000', eomodrfa);
;  267          1087  5                             END
;  268          1088  4                 END
;  269          1089  3         ELSE
;  270          1090  4             BEGIN
;  271       P  1091  4                 perform (lookup_key (.lbr$gl_control [lbr$l_curidx],
;  272          1092  4                         keydesc, .retrfa));
;  273          1093  4
;  274          1094  4                 CH$MOVE(rfa$c_length, .retrfa, readrfa);     ! Set for lbr$get_record
;  275          1095  4                 perform(read_record(readrfa, recdesc));      ! Read module header to skip it
;  276          1096  4                 IF .length NEQ mhd$c_mhdlen+.header[lhd$b_mhdusz] ! If module header not correct length
;  277          1097  4                 OR .addr[mhd$l_refcnt] EQL 0                           !  or ref count is 0
;  278          1098  4                 THEN RETURN lbr$_invrfa;                           !  then RFA is bad
;  279          1099  3                 END;
;  280          1100  3         context[ctx$v_lkpdon] = true;               ! Indicate lookup_key done
;  281          1101  2         END;
;  282          1102  2
;  283          1103  2 RETURN true;
;  284          1104  2
;  285          1105  1 END;



                                           0FFC 00000          .ENTRY  LBR$LOOKUP_KEY, Save R2,R3,R4,R5,R6,R7,R8,- ; 1019
                                                                       R9,R10,R11                                   ;
                            5E     FF70  CE 9E 00002           MOVAB   -144(SP), SP                                 ;
                            50       04  BC D0 00007           MOVL    @CTL_INDEX, R0                               ; 1058
                                  0000G  30 0000B              BSBW    VALIDATE_CTL                                 ;
                            4C       50  E9 0000E              BLBC    STATUS, 1$                                   ;
                            50       08  AC D0 00011           MOVL    KEY_NAME, R0                                 ; 1059
                      F8    AD       60  B0 00015              MOVW    (R0), KEYDESC                                ;
                      FC    AD       08  AE 9E 00019           MOVAB   KEYNAMBUF, KEYDESC+4                         ; 1060
         FC    BD     04    B0       60  28 0001E              MOVC3   (R0), @4(R0), @KEYDESC+4                     ; 1062
                            52    0000G  CF D0 00024           MOVL    LBR$GL_CONTROL, R2                           ; 1066
                            57       0A  A2 D0 00029           MOVL    10(R2), R7                                   ;
                            56       0E  A2 D0 0002D           MOVL    14(R2), R6                                   ; 1067
                            58       0C  AC D0 00031           MOVL    RETRFA, R8                                   ; 1074
               4C     04    A6       05  E1 00035              BBC     #5, 4(R6), 2$                                ; 1071
                                     58  DD 0003A              PUSHL   R8                                           ; 1074
                      F8    AD       9F 0003C                  PUSHAB  KEYDESC                                      ;
                  0000G     CF       02  FB 0003F              CALLS   #2, LBR_OLD_LKP_KEY                          ;
                            5E       50  E9 00044              BLBC    STATUS, 3$                                   ;
               28     A6    68       06  28 00047              MOVC3   #6, (R8), 40(R6)                             ; 1075
   06          00           6E       00  2C 0004C              MOVC5   #0, (SP), #0, #6, 34(R6)                     ; 1076
```

```
                                          22   A6     00051                                                   ;
                                51             6E  9E 00053          MOVAB    RECDESC, R1                     ;  1077
                                50        28   A6  9E 00056          MOVAB    40(R6), R0                      ;
                                            0000G  30 0005A          BSBW     READ_OLD_RECORD                 ;
                                6E             50  E9 0005D 1$:      BLBC     STATUS, 6$                      ;
                                1C             6E  B1 00060          CMPW     LENGTH, #28                     ;  1078
                                               5A  12 00063          BNEQ     4$                              ;
                57        04    AE             02  C1 00065          ADDL3    #2, ADDR, R7                    ;  1083
           22   A6              68             06  28 0006A          MOVC3    #6, (R8), 34(R6)                ;  1085
                                51        22   A6  9E 0006F          MOVAB    34(R6), R1                      ;  1086
                                50        02   A7  3C 00073          MOVZWL   2(R7), R0                       ;
                                57             67  3C 00077          MOVZWL   (R7), R7                        ;
                57              57             10  78 0007A          ASHL     #16, R7, R7                     ;
                                50             57  C0 0007E          ADDL2    R7, R0                          ;
                                            0000G  30 00081          BSBW     INCR_RFA                        ;
                                               41  11 00084          BRB      5$                              ;  1078
                                               58  DD 00086 2$:      PUSHL    R8                              ;  1092
                                          F8   AD  9F 00088          PUSHAB   KEYDESC                         ;
                                          12   A2  DD 0008B          PUSHL    18(R2)                          ;
                      0000V     CF             03  FB 0008E          CALLS    #3, LOOKUP_KEY                  ;
                                38             50  E9 00093          BLBC     STATUS, 6$                      ;
           28   A6              68             06  28 00096          MOVC3    #6, (R8), 40(R6)                ;  1094
                                51             6E  9E 0009B          MOVAB    RECDESC, R1                     ;  1095
                                50        28   A6  9E 0009E          MOVAB    40(R6), R0                      ;
                                            0000G  30 000A2          BSBW     READ_RECORD                     ;
                                26             50  E9 000A5 3$:      BLBC     STATUS, 6$                      ;
                                50        3C   A7  9A 000A8          MOVZBL   60(R7), R0                      ;  1096
                                50             10  C0 000AC          ADDL2    #16, R0                         ;
      50        6E              10             00  ED 000AF          CMPZV    #0, #16, LENGTH, R0             ;
                                               09  12 000B4          BNEQ     4$                              ;
                                50        04   AE  D0 000B6          MOVL     ADDR, R0                        ;  1097
                                          04   A0  D5 000BA          TSTL     4(R0)                           ;
                                               08  12 000BD          BNEQ     5$                              ;
                                50 00000000G   8F  D0 000BF 4$:      MOVL     #LBR$_INVRFA, R0                ;  1098
                                                   04 000C6          RET                                      ;
                      04        A6             02  88 000C7 5$:      BISB2    #2, 4(R6)                       ;  1100
                                50             01  D0 000CB          MOVL     #1, R0                          ;  1103
                                                   04 000CE 6$:      RET                                      ;  1105

; Routine Size:  207 bytes,    Routine Base:  $CODE$ + 003E
```

```
1 %SBTTL  'LBR$INSERT_KEY';
1 GLOBAL ROUTINE lbr$insert_key (ctl_index, key_name, rfa) =
1
1 !---
1 !
1 !       Insert a key into the current primary index.
1 !
1 ! Inputs:
1 !
1 !       ctl_index = Address of control table index.
1 !       key_name = Address of descriptor if ASCII keys,
1 !                       actual key if binary key.
1 !       rfa = Address of RFA to be associated with the key.
1 !
1 ! Outputs:
1 !
1 !       lbr$_libnotopn - library not open
1 !       lbr$_illctl - illegal control table index
1 !       lbr$_dupkey - duplicate key
1 !       lbr$_invrfa - rfa does not point at valid data
1 !---
1
2 BEGIN
2
2 MAP
2     key_name : REF BBLOCK[dsc$c_s_bln],
2     rfa : REF BBLOCK[rfa$c_length];
2
2 LOCAL
2     keydesc : BBLOCK [dsc$c_s_bln],
2     keynambuf : BBLOCK [lbr$c_maxkeylen],
2     cachentry : REF BBLOCK;
2
2 perform (validate_ctl (..ctl_index));   ! Validate control table index
2 perform (check_lock ());                ! Verify ability to modify index
2 keydesc [dsc$w_length] = .key_name [dsc$w_length];
2 keydesc [dsc$a_pointer] = keynambuf;
2 CH$MOVE (.key_name [dsc$w_length],
2         .key_name [dsc$a_pointer], .keydesc [dsc$a_pointer]);
2
3 BEGIN
3     BIND
3         index_desc = .lbr$gl_control[lbr$l_hdrptr] + lhd$c_idxdesc
3                 + (.lbr$gl_control[lbr$l_curidx]-1)*idd$c_length : BBLOCK,
3         context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK; ! Context block
3
3     IF .context[ctx$v_oldlib]                          ! Cannot insert into old library
3         OR .context [ctx$v_ronly]                      !  or one that is read only
3     THEN
3         RETURN lbr$_illop;
3
3     perform (add_key (.lbr$gl_control [lbr$l_curidx], keydesc, .rfa));
3     perform(incr_refcnt(.rfa));                                      ! Increment module refernce count
3                                                                      !  updated reference count
3     context[ctx$v_hdrdirty] = true;                                  ! Flag header is dirty
3     END;
2
```

```
;  344            1163  2 RETURN true;
;  345            1164  2
;  346            1165  1 END;




                                                      0FFC 00000         .ENTRY  LBR$INSERT_KEY, Save R2,R3,R4,R5,R6,R7,R8,- ; 1107
                                                                                 R9,R10,R11                                  ;
                                  5E       FF78   CE   9E 00002         MOVAB   -136(SP), SP                                ;
                                  50         04   BC   D0 00007         MOVL    @CTL_INDEX, R0                              ; 1139
                                              0000G   30 0000B         BSBW    VALIDATE_CTL                                ;
                                  56              50   E9 0000E         BLBC    STATUS, 3$                                  ;
                                              0000V   30 00011         BSBW    CHECK_LOCK                                  ; 1140
                                  50              50   E9 00014         BLBC    STATUS, 3$                                  ;
                                  50         08   AC   D0 00017         MOVL    KEY_NAME, R0                                ; 1141
                             F8   AD              60   B0 0001B         MOVW    (R0), KEYDESC                               ;
                             FC   AD              6E   9E 0001F         MOVAB   KEYNAMBUF, KEYDESC+4                        ; 1142
              FC    BD       04   B0              60   28 00023         MOVC3   (R0), @4(R0), @KEYDESC+4                    ; 1144
                                  50      0000G   CF   D0 00029         MOVL    LBR$GL_CONTROL, R0                          ; 1148
                                  52         0E   A0   D0 0002E         MOVL    14(R0), R2                                  ; 1150
                    05       04   A2              05   E0 00032         BBS     #5, 4(R2), 1$                               ; 1152
                                             04   A2   95 00037         TSTB    4(R2)                                       ; 1153
                                                  08   18 0003A         BGEQ    2$                                          ;
                                  50 00000000G    8F   D0 0003C 1$:     MOVL    #LBR$_ILLOP, R0                             ; 1155
                                                       04 00043         RET                                                 ;
                                             0C   AC   DD 00044 2$:     PUSHL   RFA                                         ; 1157
                                             F8   AD   9F 00047         PUSHAB  KEYDESC                                     ;
                                             12   A0   DD 0004A         PUSHL   18(R0)                                      ;
                          0000V   CF              03   FB 0004D         CALLS   #3, ADD_KEY                                 ;
                                  12              50   E9 00052         BLBC    STATUS, 3$                                  ;
                                             0C   AC   DD 00055         PUSHL   RFA                                         ; 1158
                          0000G   CF              01   FB 00058         CALLS   #1, INCR_REFCNT                             ;
                                  07              50   E9 0005D         BLBC    STATUS, 3$                                  ;
                             04   A2              08   88 00060         BISB2   #8, 4(R2)                                   ; 1160
                                  50              01   D0 00064         MOVL    #1, R0                                      ; 1163
                                                       04 00067 3$:     RET                                                 ; 1165

; Routine Size:  104 bytes,    Routine Base:  $CODE$ + 010D
```

```
1 %SBTTL  'LBR$REPLACE_KEY';
1 GLOBAL ROUTINE lbr$replace_key (ctl_index, key_name, oldrfa, newrfa) =
1
1 !---
1 !
1 !       Replace the RFA associated with a key with a new rfa.  Update
1 !       the reference counts in both the old and new module headers
1 !
1 ! Inputs:
1 !
1 !       ctl_index = Address of control table index
1 !       key_name = Address of descriptor if ASCII, key if binary
1 !       oldrfa = Address of old rfa
1 !       newrfa = Address of new rfa
1 !
1 ! Outputs:
1 !
1 !       lbr$_libnotopn - library not open
1 !       lbr$_illctl - illegal control table index
1 !       lbr$_invrfa - invalid rfa
1 !
1 !---
1
2 BEGIN
2
2 MAP
2     key_name : REF BBLOCK,
2     oldrfa : REF BBLOCK,
2     newrfa : REF BBLOCK;
2
2 LOCAL
2     keydesc : BBLOCK [dsc$c_s_bln],
2     keynambuf : BBLOCK [lbr$c_maxkeylen];
2
2 perform (validate_ctl (..ctl_index));           ! Validate control table index
2 keydesc [dsc$w_length] = .key_name [dsc$w_length];
2 keydesc [dsc$a_pointer] = keynambuf;
2 CH$MOVE (.key_name [dsc$w_length],
2         .key_name [dsc$a_pointer], .keydesc [dsc$a_pointer]);
2
3 BEGIN
3     LOCAL
3         vbn,
3         index_block,
3         offset,
3         addpos,
3         entry : REF BBLOCK;
3
3     BIND
3         context = .lbr$gl_control [lbr$l_ctxptr] : BBLOCK;
3
3     IF .context [ctx$v_oldlib]
3         OR .context [ctx$v_ronly]
3         THEN RETURN lbr$_illop;
3 !
3 ! First make sure its a real key.  If not found, treat as an insert
3 !
```

```
;  405          1223  3       IF NOT find_key (.lbr$gl_control [lbr$l_curidx], keydesc, 0,
;  406          1224  3                       vbn, index_block, offset, addpos)
;  407          1225  3           THEN RETURN lbr$insert_key (.ctl_index, .key_name, .newrfa);
;  408          1226  3       entry = .index_block + index$c_entries + .offset;    ! Point to entry
;  409          1227  3       IF NOT CH$EQL (rfa$c_length, entry [idx$b_rfa], rfa$c_length, .oldrfa)
;  410          1228  3           THEN RETURN lbr$_invrfa;
;  411          1229  3   !
;  412          1230  3   ! Decrement ref. count in old module header
;  413          1231  3   !
;  414          1232  3       perform (decr_refcnt (.oldrfa));
;  415          1233  3   !
;  416          1234  3   ! Increment ref. count in new module header
;  417          1235  3   !
;  418          1236  3       perform (incr_refcnt (.newrfa));
;  419          1237  3   !
;  420          1238  3   ! Update index entry
;  421          1239  3   !
;  422          1240  3       CH$MOVE (rfa$c_length, .newrfa, entry [idx$b_rfa]);
;  423          1241  3       mark_dirty (.vbn);                                  ! Mark index block dirty
;  424          1242  2       END;
;  425          1243  2 RETURN true
;  426          1244  1 END;                                                    ! Of lbr$replace_key




                                         0FFC 00000          .ENTRY  LBR$REPLACE_KEY, Save R2,R3,R4,R5,R6,R7,R8,-; 1167
                                                                     R9,R10,R11                                   ;
                        5E     FF68   CE   9E 00002          MOVAB   -152(SP), SP                                 ;
                        50       04   BC   D0 00007          MOVL    @CTL_INDEX, R0                               ; 1200
                                    0000G  30 0000B          BSBW    VALIDATE_CTL                                 ;
                        77            50   E9 0000E          BLBC    STATUS, 5$                                   ;
                        56       08   AC   D0 00011          MOVL    KEY_NAME, R6                                 ; 1201
                   F8   AD            66   B0 00015          MOVW    (R6), KEYDESC                                ;
                   FC   AD       10   AE   9E 00019          MOVAB   KEYNAMBUF, KEYDESC+4                         ; 1202
        FC   BD    04   B6            66   28 0001E          MOVC3   (R6), @4(R6), @KEYDESC+4                     ; 1204
                        51    0000G   CF   D0 00024          MOVL    LBR$GL_CONTROL, R1                           ; 1215
                        50       0E   A1   D0 00029          MOVL    14(R1), R0                                   ;
             05    04   A0            05   E0 0002D          BBS     #5, 4(R0), 1$                                ; 1217
                                 04   A0   95 00032          TSTB    4(R0)                                        ; 1218
                                      08   18 00035          BGEQ    2$                                           ;
                        50 00000000G  8F   D0 00037 1$:      MOVL    #LBR$_ILLOP, R0                              ; 1219
                                           04 0003E          RET                                                  ;
                                      5E   DD 0003F 2$:      PUSHL   SP                                           ; 1223
                                 08   AE   9F 00041          PUSHAB  OFFSET                                       ;
                                 10   AE   9F 00044          PUSHAB  INDEX_BLOCK                                  ;
                                 18   AE   9F 00047          PUSHAB  VBN                                          ;
                                      7E   D4 0004A          CLRL    -(SP)                                        ;
                                 F8   AD   9F 0004C          PUSHAB  KEYDESC                                      ;
                                 12   A1   DD 0004F          PUSHL   18(R1)                                       ;
                  0000V   CF          07   FB 00052          CALLS   #7, FIND_KEY                                 ;
                          0E          50   E8 00057          BLBS    R0, 3$                                       ;
                                 10   AC   DD 0005A          PUSHL   NEWRFA                                       ; 1225
                                      56   DD 0005D          PUSHL   R6                                           ;
                                 04   AC   DD 0005F          PUSHL   CTL_INDEX                                    ;
                  FF31    CF          03   FB 00062          CALLS   #3, LBR$INSERT_KEY                           ;
```

```
                                                 04 00067          RET                                                    ;
                 54       08  AE       04   AE  C1 00068 3$:      ADDL3   OFFSET, INDEX_BLOCK, R4                        ; 1226
                              54            0C  C0 0006E          ADDL2   #12, ENTRY                                     ;
            0C   BC           64            06  29 00071          CMPC3   #6, (ENTRY), @OLDRFA                           ; 1227
                                            08  13 00076          BEQL    4$                                             ;
                              50 00000000G  8F  D0 00078          MOVL    #LBR$_INVRFA, R0                               ; 1228
                                                04 0007F          RET                                                    ;
                                       0C   AC  DD 00080 4$:      PUSHL   OLDRFA                                         ; 1232
                      0000G   CF            01  FB 00083          CALLS   #1, DECR_REFCNT                                ;
                              1A            50  E9 00088 5$:      BLBC    STATUS, 6$                                     ;
                                       10   AC  DD 0008B          PUSHL   NEWRFA                                         ; 1236
                      0000G   CF            01  FB 0008E          CALLS   #1, INCR_REFCNT                                ;
                              0F            50  E9 00093          BLBC    STATUS, 6$                                     ;
                 64       10  BC            06  28 00096          MOVC3   #6, @NEWRFA, (ENTRY)                           ; 1240
                              50       0C   AE  D0 0009B          MOVL    VBN, R0                                        ; 1241
                                         0000V  30 0009F          BSBW    MARK_DIRTY                                     ;
                              50            01  D0 000A2          MOVL    #1, R0                                         ; 1243
                                                04 000A5 6$:      RET                                                    ; 1244

; Routine Size:  166 bytes,    Routine Base:  $CODE$ + 0175
;   428           1245  1 %SBTTL  'LBR$DELETE_KEY';
;   429           1246  1 GLOBAL ROUTINE lbr$delete_key (ctl_index, key_name) =
;   430           1247  1
;   431           1248  1 !---
;   432           1249  1 !
;   433           1250  1 !       Delete a specified key from the current primary index.
;   434           1251  1 !
;   435           1252  1 ! Inputs:
;   436           1253  1 !
;   437           1254  1 !       ctl_index = Address of control table index.
;   438           1255  1 !       key_name = Address of string desciptor or binary key.
;   439           1256  1 !
;   440           1257  1 ! Outputs:
;   441           1258  1 !
;   442           1259  1 !       lbr$_libnotopn - library not open
;   443           1260  1 !       lbr$_illctl - illegal control table index
;   444           1261  1 !       lbr$_keynotfnd - key not found
;   445           1262  1 !---
;   446           1263  1
;   447           1264  2 BEGIN
;   448           1265  2
;   449           1266  2 MAP
;   450           1267  2     key_name : REF BBLOCK;
;   451           1268  2
;   452           1269  2 LOCAL
;   453           1270  2     keydesc : BBLOCK [dsc$c_s_bln],
;   454           1271  2     keynambuf : BBLOCK [lbr$c_maxkeylen];
;   455           1272  2
;   456           1273  2 perform (validate_ctl (..ctl_index));   ! Validate control table index
;   457           1274  2 perform (check_lock ());               ! Verify ability to modify index
;   458           1275  2 keydesc [dsc$w_length] = .key_name [dsc$w_length];
;   459           1276  2 keydesc [dsc$a_pointer] = keynambuf;
;   460           1277  2 CH$MOVE (.key_name [dsc$w_length],
;   461           1278  2         .key_name [dsc$a_pointer], .keydesc [dsc$a_pointer]);
;   462           1279  2
;   463           1280  2
;   464           1281  2 perform (delete_key (keydesc));         ! Delete the key
;   465           1282  2 RETURN true
;   466           1283  1 END;



                                      0FFC 00000          .ENTRY  LBR$DELETE_KEY, Save R2,R3,R4,R5,R6,R7,R8,-  ; 1246
                                                                  R9,R10,R11                                   ;
                     5E     FF78   CE  9E 00002           MOVAB   -136(SP), SP                                 ;
                     50       04   BC  D0 00007           MOVL    @CTL_INDEX, R0                               ; 1273
                                0000G  30 0000B           BSBW    VALIDATE_CTL                                 ;
                     26            50  E9 0000E           BLBC    STATUS, 1$                                   ;
                                0000V  30 00011           BSBW    CHECK_LOCK                                   ; 1274
                     20            50  E9 00014           BLBC    STATUS, 1$                                   ;
                     50       08   AC  D0 00017           MOVL    KEY_NAME, R0                                 ; 1275
                F8   AD            60  B0 0001B           MOVW    (R0), KEYDESC                                ;
                FC   AD            6E  9E 0001F           MOVAB   KEYNAMBUF, KEYDESC+4                         ; 1276
   FC    BD     04   B0            60  28 00023           MOVC3   (R0), @4(R0), @KEYDESC+4                     ; 1278
                              F8   AD  9F 00029           PUSHAB  KEYDESC                                      ; 1281
```

```
                                  0000V  CF           01  FB 0002C         CALLS    #1, DELETE_KEY                          ;
                                         03           50  E9 00031         BLBC     STATUS, 1$                              ;
                                         50           01  D0 00034         MOVL     #1, R0                                  ; 1282
                                                          04 00037 1$:     RET                                              ; 1283

; Routine Size:  56 bytes,    Routine Base:  $CODE$ + 021B
;   468          1284  1 %SBTTL  'delete_key';
;   469          1285  1 GLOBAL ROUTINE delete_key (key_name) =
;   470          1286  1
;   471          1287  1 !---
;   472          1288  1 !
;   473          1289  1 !                 Delete a key from the current primary index
;   474          1290  1 !
;   475          1291  1 ! Inputs:
;   476          1292  1 !
;   477          1293  1 !         key_name = Address of string descriptor or binary key
;   478          1294  1 !
;   479          1295  1 ! Outputs:
;   480          1296  1 !
;   481          1297  1 !---
;   482          1298  1
;   483          1299  2 BEGIN
;   484          1300  2
;   485          1301  2 LOCAL
;   486          1302  2     localrfa : BBLOCK[rfa$c_length];
;   487          1303  2
;   488          1304  2 BIND
;   489          1305  2     context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK;
;   490          1306  2
;   491          1307  2 IF .context[ctx$v_oldlib]                         ! Cannot modify old libraries
;   492          1308  2     OR .context [ctx$v_ronly]                     !  or read only libraries
;   493          1309  2 THEN
;   494          1310  2     RETURN lbr$_illop;
;   495          1311  2
;   496        P 1312  2 perform(lookup_key(.lbr$gl_control[lbr$l_curidx],
;   497          1313  2             .key_name, localrfa));
;   498          1314  2
;   499          1315  2 perform (remove_key (.lbr$gl_control [lbr$l_curidx], .key_name));
;   500          1316  2
;   501          1317  2 perform(decr_refcnt(localrfa));                         !Decrement reference count
;   502          1318  2
;   503          1319  2 context[ctx$v_hdrdirty] = true;                        !Flag header is dirty
;   504          1320  2
;   505          1321  2 RETURN true;
;   506          1322  2
;   507          1323  1 END;



                                        0004 00000         .ENTRY  DELETE_KEY, Save R2                                 ; 1285
                      5E             08  C2 00002          SUBL2   #8, SP                                              ;
                      50      0000G  CF  D0 00005          MOVL    LBR$GL_CONTROL, R0                                  ; 1305
                      52         0E  A0  D0 0000A          MOVL    14(R0), R2                                          ;
          05     04   A2             05  E0 0000E          BBS     #5, 4(R2), 1$                                       ; 1307
                                 04  A2  95 00013          TSTB    4(R2)                                               ; 1308
                                     08  18 00016          BGEQ    2$                                                  ;
                      50 00000000G   8F  D0 00018 1$:      MOVL    #LBR$_ILLOP, R0                                     ; 1310
                                         04 0001F          RET                                                         ;
                                     5E  DD 00020 2$:      PUSHL   SP                                                  ; 1313
                                 04  AC  DD 00022          PUSHL   KEY_NAME                                            ;
                                 12  A0  DD 00025          PUSHL   18(R0)                                              ;
```

```
                          0000V  CF            03  FB 00028          CALLS   #3, LOOKUP_KEY                         ;
                                 24            50  E9 0002D          BLBC    STATUS, 3$                             ;
                                          04   AC  DD 00030          PUSHL   KEY_NAME                               ; 1315
                             50        0000G   CF  D0 00033          MOVL    LBR$GL_CONTROL, R0                     ;
                                          12   A0  DD 00038          PUSHL   18(R0)                                 ;
                          0000V  CF            02  FB 0003B          CALLS   #2, REMOVE_KEY                         ;
                                 11            50  E9 00040          BLBC    STATUS, 3$                             ;
                                               5E  DD 00043          PUSHL   SP                                     ; 1317
                          0000G  CF            01  FB 00045          CALLS   #1, DECR_REFCNT                        ;
                                 07            50  E9 0004A          BLBC    STATUS, 3$                             ;
                             04  A2            08  88 0004D          BISB2   #8, 4(R2)                              ; 1319
                                 50            01  D0 00051          MOVL    #1, R0                                 ; 1321
                                                   04 00054 3$:      RET                                            ; 1323

; Routine Size:  85 bytes,    Routine Base:  $CODE$ + 0253
```

```
1 %SBTTL  'LBR$GET_INDEX';
1 GLOBAL ROUTINE lbr$get_index (ctl_index, index, user_routine, match_desc) =
1
1 !---
1 !
1 !       Call a user-supplied routine for each key in the specified
1 !       primary index.
1 !
1 ! Inputs:
1 !
1 !       ctl_index = Address of the control table index
1 !       index = Address of the primary index number
1 !       user_routine = Address of user action routine
1 !       match_desc = Address (optional) of string descriptor for matching
1 !
1 ! Outputs:
1 !
1 !       The action routine is called once for each key in the index.
1 !
1 !       lbr$_libnotopn - library not open
1 !       lbr$_illctl - illegal control table index
1 !       lbr$_illidxnum - illegal index number
1 !---
1
2 BEGIN
2
2 MAP
2     match_desc : REF BBLOCK;
2
2 LOCAL
2     keydesc : BBLOCK [dsc$c_s_bln],
2     keynambuf : BBLOCK [lbr$c_maxkeylen],
2     wildcard;
2
2 BUILTIN
2     NULLPARAMETER;              ! True if argument unspecified
2
2 perform (validate_ctl (..ctl_index));   ! Validate control table index
2
3 BEGIN
3     BIND
3         header = .lbr$gl_control [lbr$l_hdrptr] : BBLOCK, ! Address the library header
3         context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK,
3         index_desc = .lbr$gl_control[lbr$l_hdrptr] + lhd$c_idxdesc
3                 + (.lbr$gl_control[lbr$l_curidx]-1)*idd$c_length : BBLOCK;
3
3     IF ..index GTRU .header [lhd$b_nindex]      ! If illegal index number,
3     OR ..index EQL 0
3     THEN
3         RETURN lbr$_illidxnum;          ! return with error
3
3     wildcard = false;                               ! Assume no wildcards
3     IF NOT NULLPARAMETER(4)                         ! If argument is present
3         AND .match_desc [dsc$w_length] NEQ 0        !  and non-null
3         AND .match_desc [dsc$a_pointer] NEQ 0       !   ...
4         THEN BEGIN                                  ! Then do wild card matching
4             wildcard = true;                        ! then there is a match descriptor
```

```
;  566          1381 4              keydesc [dsc$w_length] = .match_desc [dsc$w_length];
;  567          1382 4              keydesc [dsc$a_pointer] = keynambuf;
;  568          1383 4              IF .index_desc [idd$v_nocasecmp]
;  569          1384 4              THEN
;  570          1385 4                  CH$MOVE (.match_desc [dsc$w_length],
;  571          1386 4                          .match_desc [dsc$a_pointer], .keydesc [dsc$a_pointer])
;  572          1387 4              ELSE
;  573          1388 4                  perform (make_upper_case (.match_desc, keydesc, true));
;  574          1389 3              END;
;  575          1390 3
;  576          1391 3      context [ctx$v_found1] = false;             !Flag no matches found
;  577          1392 3      IF .context[ctx$v_oldlib]                   ! If old format library
;  578        P 1393 3      THEN perform (lbr_old_get_idx (..index, .user_routine, (IF .wildcard
;  579        P 1394 3                                                                 THEN .match_desc
;  580          1395 4                                                                 ELSE 0)))
;  581          1396 4
;  582        P 1397 3      ELSE perform (traverse_keys (..index, (IF .wildcard           ! Traverse the index
;  583        P 1398 3                                          THEN check_wild           ! looking for matches
;  584        P 1399 3                                          ELSE call_user), .user_routine, ! or just calling user
;  585        P 1400 3                                       (IF .wildcard
;  586        P 1401 3                                          THEN .match_desc
;  587          1402 3                                          ELSE 0)));
;  588          1403 3      IF NOT .context [ctx$v_found1]                                  !If no matches found
;  589          1404 4          THEN RETURN (IF .wildcard
;  590          1405 4                          THEN lbr$_nomtchfou
;  591          1406 4                          ELSE lbr$_nulidx
;  592          1407 4                          )
;  593          1408 3          ELSE RETURN true;
;  594          1409 3
;  595          1410 2      END;
;  596          1411 2
;  597          1412 1 END;                                                                 !Of lbr$get_index



                                          OFFC 00000          .ENTRY  LBR$GET_INDEX, Save R2,R3,R4,R5,R6,R7,R8,-  ; 1325
                                                                      R9,R10,R11                                  ;
                            5E     FF78   CE   9E 00002       MOVAB   -136(SP), SP                                ;
                            50       04   BC   D0 00007       MOVL    @CTL_INDEX, R0                              ; 1361
                                      0000G   30 0000B        BSBW    VALIDATE_CTL                                ;
                            70         50   E9 0000E          BLBC    STATUS, 4$                                  ;
                            50    0000G   CF   D0 00011       MOVL    LBR$GL_CONTROL, R0                          ; 1365
                            52       0A   A0   D0 00016       MOVL    10(R0), R2                                  ;
                            56       0E   A0   D0 0001A       MOVL    14(R0), R6                                  ; 1366
                            51       12   A0   D0 0001E       MOVL    18(R0), R1                                  ; 1368
                            51    0A B041   7E 00022          MOVAQ   @10(R0)[R1], R1                             ;
                            51     00BC   C1   9E 00027       MOVAB   188(R1), R1                                 ;
     08   BC       01   A2  08            00   ED 0002C       CMPZV   #0, #8, 1(R2), @INDEX                       ; 1370
                                          05   1F 00033       BLSSU   1$                                          ;
                                     08   BC   D5 00035       TSTL    @INDEX                                      ; 1371
                                          08   12 00038       BNEQ    2$                                          ;
                            50 00000000G  8F   D0 0003A 1$:   MOVL    #LBR$_ILLIDXNUM, R0                         ; 1373
                                               04 00041       RET                                                 ;
                                          57   D4 00042 2$:   CLRL    WILDCARD                                    ; 1375
                            04            6C   91 00044       CMPB    (AP), #4                                    ; 1376
```

```
                                   3B  1F 00047          BLSSU   5$                                  ;
                          10       AC  D5 00049          TSTL    16(AP)                              ;
                                   36  13 0004C          BEQL    5$                                  ;
                          10       BC  B5 0004E          TSTW    @MATCH_DESC                         ; 1377
                                   31  13 00051          BEQL    5$                                  ;
                 50       10       AC  D0 00053          MOVL    MATCH_DESC, R0                      ; 1378
                          04       A0  D5 00057          TSTL    4(R0)                               ;
                                   28  13 0005A          BEQL    5$                                  ;
                 57                01  D0 0005C          MOVL    #1, WILDCARD                        ; 1380
                 50       10       AC  D0 0005F          MOVL    MATCH_DESC, R0                      ; 1381
           F8    AD                60  B0 00063          MOVW    (R0), KEYDESC                       ;
           FC    AD                6E  9E 00067          MOVAB   KEYNAMBUF, KEYDESC+4                ; 1382
      08         61                03  E1 0006B          BBC     #3, (R1), 3$                        ; 1383
FC    BD   04    B0                60  28 0006F          MOVC3   (R0), @4(R0), @KEYDESC+4            ; 1386
                                   0D  11 00075          BRB     5$                                  ; 1385
                 51       F8       AD  9E 00077 3$:      MOVAB   KEYDESC, R1                         ; 1388
                 52                01  D0 0007B          MOVL    #1, R2                              ;
                                0000G  30 0007E          BSBW    MAKE_UPPER_CASE                     ;
                 65                50  E9 00081 4$:      BLBC    STATUS, 16$                         ;
           04    A6       40       8F  8A 00084 5$:      BICB2   #64, 4(R6)                          ; 1391
      17   04    A6                05  E1 00089          BBC     #5, 4(R6), 8$                       ; 1392
                 05                57  E9 0008E          BLBC    WILDCARD, 6$                        ; 1395
                          10       AC  DD 00091          PUSHL   MATCH_DESC                          ;
                                   02  11 00094          BRB     7$                                  ;
                                   7E  D4 00096 6$:      CLRL    -(SP)                               ;
                          0C       AC  DD 00098 7$:      PUSHL   USER_ROUTINE                        ;
                          08       BC  DD 0009B          PUSHL   @INDEX                              ;
        0000G    CF                03  FB 0009E          CALLS   #3, LBR_OLD_GET_IDX                 ;
                                   26  11 000A3          BRB     13$                                 ;
                 05                57  E9 000A5 8$:      BLBC    WILDCARD, 9$                        ; 1402
                          10       AC  DD 000A8          PUSHL   MATCH_DESC                          ;
                                   02  11 000AB          BRB     10$                                 ;
                                   7E  D4 000AD 9$:      CLRL    -(SP)                               ;
                          0C       AC  DD 000AF 10$:     PUSHL   USER_ROUTINE                        ;
                 07                57  E9 000B2          BLBC    WILDCARD, 11$                       ;
                 50    0000V       CF  9E 000B5          MOVAB   CHECK_WILD, R0                      ;
                                   05  11 000BA          BRB     12$                                 ;
                 50    0000V       CF  9E 000BC 11$:     MOVAB   CALL_USER, R0                       ;
                                   50  DD 000C1 12$:     PUSHL   R0                                  ;
                          08       BC  DD 000C3          PUSHL   @INDEX                              ;
        0000V    CF                04  FB 000C6          CALLS   #4, TRAVERSE_KEYS                   ;
                 1B                50  E9 000CB 13$:     BLBC    STATUS, 16$                         ;
      13   04    A6                06  E0 000CE          BBS     #6, 4(R6), 15$                      ; 1403
                 08                57  E9 000D3          BLBC    WILDCARD, 14$                       ; 1404
                 50 00000000G      8F  D0 000D6          MOVL    #LBR$_NOMTCHFOU, R0                 ;
                                       04 000DD          RET                                         ;
                 50 00000000G      8F  D0 000DE 14$:     MOVL    #LBR$_NULIDX, R0                    ;
                                       04 000E5          RET                                         ; 1408
                 50                01  D0 000E6 15$:     MOVL    #1, R0                              ;
                                       04 000E9 16$:     RET                                         ; 1412

; Routine Size:  234 bytes,    Routine Base:  $CODE$ + 02A8
;   599          1413   1 %SBTTL  'LBR$SEARCH';
;   600          1414   1 GLOBAL ROUTINE lbr$search (ctl_index, index, rfa, user_routine) =
;   601          1415   1
;   602          1416   1 !---
;   603          1417   1 !
;   604          1418   1 !       Search a specified primary index for all keys associated
;   605          1419   1 !       with a given RFA.  The user supplied action routine will
;   606          1420   1 !       be called for each key associated with the RFA.
;   607          1421   1 !
;   608          1422   1 ! Inputs:
;   609          1423   1 !
;   610          1424   1 !       ctl_index = Address of the control table index
;   611          1425   1 !       index = Address of the primary index number
;   612          1426   1 !       rfa = Address of the RFA to be searched for
;   613          1427   1 !       user_routine = Address of user supplied action routine.
;   614          1428   1 !
;   615          1429   1 ! Outputs:
;   616          1430   1 !
;   617          1431   1 !       The action routine will be called for each key found.
;   618          1432   1 !
;   619          1433   1 !---
;   620          1434   1
;   621          1435   2 BEGIN
;   622          1436   2
;   623          1437   2 MAP
;   624          1438   2     rfa: REF BBLOCK;            ! Access as RFA structure
;   625          1439   2
;   626          1440   2 ROUTINE check_rfa (entry, user_routine, index_desc, test_rfa) =
;   627          1441   3 BEGIN
;   628          1442   3 MAP
;   629          1443   3     test_rfa : REF BBLOCK[rfa$c_length],
;   630          1444   3     index_desc: REF BBLOCK,
;   631          1445   3     entry: REF BBLOCK;
;   632          1446   3 IF .entry [idx$l_vbn] EQL .test_rfa [rfa$l_vbn]
;   633          1447   3     AND .entry [idx$w_offset] EQL .test_rfa [rfa$w_offset]
;   634          1448   3 THEN
;   635          1449   3     perform (call_user (.entry, .user_routine, .index_desc));
;   636          1450   3 RETURN true;
;   637          1451   2 END;



                                                       0000 00000 CHECK_RFA:
                                                                          .WORD   Save nothing                                      ; 1440
                           50        04    AC   D0 00002           MOVL    ENTRY, R0                                         ; 1446
                           51        10    AC   D0 00006           MOVL    TEST_RFA, R1
                           61              60   D1 0000A           CMPL    (R0), (R1)                                        ;
                                           15   12 0000D           BNEQ    1$                                                ;
                  04       A1        04    A0   B1 0000F           CMPW    4(R0), 4(R1)                                      ; 1447
                                           0E   12 00014           BNEQ    1$                                                ;
                           7E        08    AC   7D 00016           MOVQ    USER_ROUTINE, -(SP)                               ; 1449
                                           50   DD 0001A           PUSHL   R0                                                ;
               0000V       CF              03   FB 0001C           CALLS   #3, CALL_USER                                     ;
                           03              50   E9 00021           BLBC    STATUS, 2$                                        ;
                           50              01   D0 00024 1$:       MOVL    #1, R0                                            ; 1450
```

```
                                            04 00027 2$:      RET                                                          ; 1451

; Routine Size:  40 bytes,    Routine Base:  $CODE$ + 0392


;  638          1452  2
;  639          1453  2
;  640          1454  2 perform (validate_ctl (..ctl_index));   ! Validate control table index
;  641          1455  2
;  642          1456  3 BEGIN
;  643          1457  3     BIND
;  644          1458  3         context = .lbr$gl_control [lbr$l_ctxptr] : BBLOCK, ! Address the context block
;  645          1459  3         header = .lbr$gl_control [lbr$l_hdrptr] : BBLOCK; ! Address the library header
;  646          1460  3
;  647          1461  3     IF ..index GTRU .header [lhd$b_nindex]      ! If illegal index number,
;  648          1462  3     OR ..index EQL 0
;  649          1463  3     THEN
;  650          1464  3         RETURN lbr$_illidxnum;           ! return with error
;  651          1465  3
;  652          1466  3     IF .context[ctx$v_oldlib]           ! If old format library
;  653          1467  3     THEN RETURN lbr_old_src_idx (..index, .rfa, .user_routine);
;  654          1468  3
;  655          1469  3     perform (traverse_keys (..index, check_rfa, .user_routine, .rfa));
;  656          1470  2     END;
;  657          1471  2
;  658          1472  2 RETURN true;
;  659          1473  2
;  660          1474  1 END;



                                         0FFC 00000           .ENTRY  LBR$SEARCH, Save R2,R3,R4,R5,R6,R7,R8,R9,-      ; 1414
                                                                      R10,R11                                           ;
                          50        04    BC  D0 00002           MOVL    @CTL_INDEX, R0                                 ; 1454
                                     0000G 30 00006           BSBW    VALIDATE_CTL                                      ;
                          48            50  E9 00009           BLBC    STATUS, 4$                                       ;
                          50    0000G   CF  D0 0000C           MOVL    LBR$GL_CONTROL, R0                               ; 1458
                          50        0A    A0  7D 00011           MOVQ    10(R0), R0                                     ; 1459
     08   BC     01   A0              08            00  ED 00015           CMPZV   #0, #8, 1(R0), @INDEX                ; 1461
                                        05  1F 0001C           BLSSU   1$                                               ;
                                08    BC  D5 0001E           TSTL    @INDEX                                             ; 1462
                                        08  12 00021           BNEQ    2$                                               ;
                          50 00000000G   8F  D0 00023 1$:      MOVL    #LBR$_ILLIDXNUM, R0                              ; 1464
                                        04 0002A           RET                                                          ;
                   0D       04    A1            05  E1 0002B 2$:      BBC     #5, 4(R1), 3$                             ; 1466
                          7E        0C    AC  7D 00030           MOVQ    RFA, -(SP)                                     ; 1467
                                08    BC  DD 00034           PUSHL   @INDEX                                             ;
                 0000G   CF            03  FB 00037           CALLS   #3, LBR_OLD_SRC_IDX                               ;
                                        04 0003C           RET                                                          ;
                                0C    AC  DD 0003D 3$:      PUSHL   RFA                                                 ; 1469
                                10    AC  DD 00040           PUSHL   USER_ROUTINE                                       ;
                                92    AF  9F 00043           PUSHAB  CHECK_RFA                                          ;
                                08    BC  DD 00046           PUSHL   @INDEX                                             ;
                 0000V   CF            04  FB 00049           CALLS   #4, TRAVERSE_KEYS                                 ;
                          03            50  E9 0004E           BLBC    STATUS, 4$                                       ;
                          50           01  D0 00051          MOVL    #1, R0                                      ; 1472
                                           04 00054 4$:      RET                                                 ; 1474

; Routine Size:  85 bytes,    Routine Base:  $CODE$ + 03BA
;  662       1475  1 %SBTTL  'check_wild';
;  663       1476  1 ROUTINE check_wild (entry, user_routine, index_desc, match_desc) =
;  664       1477  2 BEGIN
;  665       1478  2 !---
;  666       1479  2 !
;  667       1480  2 !       Called by traverse for each entry in the index.  Check to
;  668       1481  2 !       see if current entry matches the match_desc.  Call user if so.
;  669       1482  2 ! Inputs:
;  670       1483  2 !
;  671       1484  2 !       entry = Address of key entry
;  672       1485  2 !       user_routine = Address of user action routine
;  673       1486  2 !       index_desc = Address of index descriptor for index
;  674       1487  2 !       match_desc = string descriptor for match string
;  675       1488  2 !
;  676       1489  2 !---
;  677       1490  2 MAP
;  678       1491  2     entry : REF BBLOCK,
;  679       1492  2     index_desc : REF BBLOCK,
;  680       1493  2     match_desc : REF BBLOCK;
;  681       1494  2 LOCAL
;  682       1495  2     entrykey : BBLOCK [lbr$c_maxkeylen];
;  683       1496  2
;  684       1497  2 IF .index_desc [idd$v_upcasntry]
;  685       1498  2 THEN
;  686       1499  3     BEGIN
;  687       1500  3     moveto_upper_case (.entry [idx$b_keylen], entry [idx$t_keyname], entrykey)
;  688       1501  3     END
;  689       1502  2 ELSE
;  690       1503  2     CH$MOVE (.entry [idx$b_keylen], entry [idx$t_keyname], entrykey);
;  691       1504  2
;  692       1505  3 IF (NOT .index_desc [idd$v_ascii]                   ! If not ASCII keys
;  693       1506  4  OR (fmg$match_name (.entry [idx$b_keylen], entrykey,
;  694       1507  4                      .match_desc [dsc$w_length],
;  695       1508  4                      .match_desc [dsc$a_pointer])
;  696       1509  4         OR CH$EQL (.match_desc [dsc$w_length], entrykey,
;  697       1510  4                      .match_desc [dsc$w_length],
;  698       1511  3                      .match_desc [dsc$a_pointer])))
;  699       1512  2     THEN perform (call_user (.entry, .user_routine, .index_desc, .match_desc));
;  700       1513  2 RETURN true
;  701       1514  1 END;                                                 !Of check_wild



                                          0FFC 00000 CHECK_WILD:
                                                           .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 1476
                      5E       80   AE  9E 00002           MOVAB   -128(SP), SP                                  ;
                      50       04   AC  D0 00006           MOVL    ENTRY, R0                                     ; 1500
                      57       04   AC  D0 0000A           MOVL    ENTRY, R7                                     ;
      10        0C    BC            05  E1 0000E           BBC     #5, @INDEX_DESC, 1$                           ; 1497
                      52            6E  9E 00013           MOVAB   ENTRYKEY, R2                                  ; 1500
                      51       07   A0  9E 00016           MOVAB   7(R0), R1                                     ;
                      50       06   A7  9A 0001A           MOVZBL  6(R7), R0                                     ;
                               0000G  30 0001E           BSBW    MOVETO_UPPER_CASE                             ;
                                    09  11 00021           BRB     2$                                            ; 1499
                      51       06   A7  9A 00023 1$:       MOVZBL  6(R7), R1                                     ; 1503
```

```
                                                                          E  1
LBR_INDEX                                                           16-Sep-1984 01:56:12    VAX-11 Bliss-32 V4.0-742              Page  26
V04-000         check_wild                                          14-Sep-1984 12:37:41    DISK$VMSMASTER:[LBR.SRC]INDEX.B32;1    (11)

                6E      07   A0              51  28 00027        MOVC3   R1, 7(R0), ENTRYKEY                          ;
                             1F        0C    BC  E9 0002C 2$:    BLBC    @INDEX_DESC, 3$                              ; 1505
                             56        10    AC  D0 00030        MOVL    MATCH_DESC, R6                               ; 1508
                             53              6E  9E 00034        MOVAB   ENTRYKEY, R3                                 ; 1506
                             55        04    A6  D0 00037        MOVL    4(R6), R5                                    ;
                             54              66  3C 0003B        MOVZWL  (R6), R4                                     ;
                             52        06    A7  9A 0003E        MOVZBL  6(R7), R2                                    ;
                                          0000G  30 00042        BSBW    FMG$MATCH_NAME                               ;
                             07              50  E8 00045        BLBS    R0, 3$                                       ;
           04   B6           6E              66  29 00048        CMPC3   (R6), ENTRYKEY, @4(R6)                       ; 1509
                                             10  12 0004D        BNEQ    4$                                           ;
                             7E        0C    AC  7D 0004F 3$:    MOVQ    INDEX_DESC, -(SP)                            ; 1512
                             7E        04    AC  7D 00053        MOVQ    ENTRY, -(SP)                                 ;
                     0000V   CF              04  FB 00057        CALLS   #4, CALL_USER                                ;
                             03              50  E9 0005C        BLBC    STATUS, 5$                                   ;
                             50              01  D0 0005F 4$:    MOVL    #1, R0                                       ; 1513
                                                 04 00062 5$:    RET                                                  ; 1514

; ..outine Size:  99 bytes,    Routine Base:  $CODE$ + 040F
;  703          1515  1 %SBTTL  'call_user';
;  704          1516  1 ROUTINE call_user (entry, user_routine, index_desc, rfa) =
;  705          1517  1
;  706          1518  1 !---
;  707          1519  1 !
;  708          1520  1 !       This routine is used as an action routine by GET_INDEX
;  709          1521  1 !       and SEARCH to call the user with a standard argument
;  710          1522  1 !       list for a given key entry.
;  711          1523  1 !
;  712          1524  1 ! Inputs:
;  713          1525  1 !
;  714          1526  1 !       entry = Address of key entry
;  715          1527  1 !       user_routine = Address of user action routine
;  716          1528  1 !       index = Primary index number
;  717          1529  1 !
;  718          1530  1 ! Outputs:
;  719          1531  1 !
;  720          1532  1 !       The user routine is called with the following arguments:
;  721          1533  1 !               1) If ascii keys, address of key descriptor
;  722          1534  1 !                  If binary keys, address of longword key
;  723          1535  1 !               2) Address of RFA associated with the key
;  724          1536  1 !---
;  725          1537  1
;  726          1538  2 BEGIN
;  727          1539  2
;  728          1540  2 MAP
;  729          1541  2     index_desc: REF BBLOCK,             ! Address of index descriptor
;  730          1542  2     entry: REF BBLOCK;                  ! Address of key entry
;  731          1543  2
;  732          1544  2 BIND
;  733          1545  2     context = .lbr$gl_control [lbr$l_ctxptr] : BBLOCK;
;  734          1546  2
;  735          1547  2 context [ctx$v_found1] = true;          ! Flag match found
;  736          1548  2 IF .index_desc [idd$v_ascii]            ! If ASCII keys,
;  737          1549  2 THEN
;  738          1550  3     BEGIN
;  739          1551  3     LOCAL desc: BBLOCK [dsc$c_s_bln];   ! String descriptor
;  740          1552  3     desc [dsc$w_length] = .entry [idx$b_keylen];
;  741          1553  3     desc [dsc$a_pointer] = entry [idx$t_keyname];
;  742          1554  3     perform ((.user_routine) (desc, entry [idx$l_vbn])); ! Call user back
;  743          1555  3     END
;  744          1556  2 ELSE
;  745          1557  2     perform ((.user_routine) (entry [idx$l_keyid], entry [idx$l_vbn]));
;  746          1558  2
;  747          1559  2 RETURN true;
;  748          1560  2
;  749          1561  1 END;



                                            0000 00000 CALL_USER:
                                                             .WORD   Save nothing                                   ; 1516
                      5E              08  C2 00002            SUBL2   #8, SP                                         ;
                      50      0000G   CF  D0 00005            MOVL    LBR$GL_CONTROL, R0                             ; 1545
                      50         0E   A0  D0 0000A            MOVL    14(R0), R0                                     ;
```

```
                         04  A0     40  8F  88 0000E          BISB2   #64, 4(R0)                    ; 1547
                             50     04  AC  D0 00013          MOVL    ENTRY, R0                     ; 1552
                             12     0C  BC  E9 00017          BLBC    @INDEX_DESC, 1$               ; 1548
                             6E     06  A0  9B 0001B          MOVZBW  6(R0), DESC                   ; 1552
            04   AE      04  AC         07  C1 0001F          ADDL3   #7, ENTRY, DESC+4             ; 1553
                                    04  AC  DD 00025          PUSHL   ENTRY                         ; 1554
                                    04  AE  9F 00028          PUSHAB  DESC                          ;
                                        06  11 0002B          BRB     2$                            ;
                                    04  AC  DD 0002D 1$:      PUSHL   ENTRY                         ; 1557
                                    06  A0  9F 00030          PUSHAB  6(R0)                         ;
                         08  BC         02  FB 00033 2$:      CALLS   #2, @USER_ROUTINE             ;
                             03         50  E9 00037          BLBC    STATUS, 3$                    ;
                             50         01  D0 0003A          MOVL    #1, R0                        ; 1559
                                            04 0003D 3$:      RET                                   ; 1561

; Routine Size:  62 bytes,    Routine Base:  $CODE$ + 0472
```

```
  1 %SBTTL  'add_key';
  1 GLOBAL ROUTINE add_key (index, key_desc, key_rfa, stop_vbn) =
  1 !---
  1 !
  1 !       This routine adds a key to a specified index.  If the index
  1 !       block is full, the block is split and a parent index block
  1 !       is created and is made to point to the 2 split index blocks.
  1 !
  1 ! Inputs:
  1 !
  1 !       index = Primary index number in which key is to be added.
  1 !       key_desc = Descriptor of key (ascii or binary) to be added.
  1 !       key_rfa = RFA to be associated with key.
  1 !       stop_vbn = (Optional) The VBN of an index block in the
  1 !                       index tree into which the key should be added.
  1 !                       If not specified, key added at bottom of tree.
  1 !
  1 ! Outputs:
  1 !
  1 !       Routine value = Success/failure status code
  1 !
  1 !---
  2 BEGIN
  2
  2 MAP
  2     key_desc: REF BBLOCK,                   ! Access as string descriptor
  2     key_rfa: REF BBLOCK;                    ! Access as RFA structure
  2
  2 LOCAL
  2     status,
  2     index_desc: REF BBLOCK,                 ! Index descriptor
  2     entry_size,                             ! Size of each index entry
  2     index_block1: REF BBLOCK,               ! Address of index block
  2     vbn1,                                   ! VBN of current index block
  2     genpos,                                 ! Offset to closest entry
  2     addpos;                                 ! Offset where to add key
  2
  2 BUILTIN
  2     NULLPARAMETER;                  ! True if argument unspecified
  2
  2 MACRO
M 2     entry (address,b) =
M 2         (address+index$c_entries+b)
  2         %IF %LENGTH GTR 2 %THEN <%REMAINING> %ELSE <0,0,0> %FI%;
  2
  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
  2               + (.index-1)*idd$c_length;
  2 !
  2 !   Use false option to check keyword and remove trailing blanks
  2 !
  2 perform (make_upper_case (.key_desc, .key_desc, false));
  2 !
  2 !       Check for illegal key length if ASCII keys
  2 !
  2 IF .index_desc [idd$v_ascii]
  2 THEN
  4     IF ((.key_desc [dsc$w_length] GTR .index_desc [idd$w_keylen]) ! If name too long
        OR (.key_desc [dsc$w_length] EQL 0))                      !  or zero length name
    THEN
        RETURN lbr$_invkey;                                       ! Then return with an error
!
!       If no primary index block exists yet, create the block.
!
IF .index_desc [idd$l_vbn] EQL 0        ! If no primary index block yet,
THEN
    BEGIN
    perform(create_index(vbn1, index_block1));  ! Create index block
    index_desc [idd$l_vbn] = .vbn1;      ! Set as root of tree
    index_block1 [index$l_parent] = 0;  ! Set backward link
    END;
!
!       Find the key in the index tree.
!
status = find_key(.index, .key_desc,
        (IF NOT NULLPARAMETER(4) THEN .stop_vbn ELSE 0),
        vbn1, index_block1, genpos, addpos);
!
!       If key found, return duplicate key
!
IF .status                              ! If found,
THEN
    RETURN lbr$_dupkey;                 ! Return duplicate key
!
!       If the current block is full, split the index block into
!       2 blocks and create a parent index block if necessary.
!
IF .index_desc [idd$v_varlenidx]
THEN
    entry_size = idx$c_rfaplsbyt + .key_desc[dsc$w_length]
ELSE
    entry_size = idx$c_length + .index_desc [idd$w_keylen];

IF .index_block1 [index$w_used] + .entry_size GTRU index$c_blksiz
THEN
    BEGIN
    LOCAL
        cur_entry : REF BBLOCK,         ! step through index entry at a time
        last_entry,
        last_used,                      ! location of last used byte in index block
        move_length,                    ! Length of half the block
        ptr,
        index_block2: REF BBLOCK,       ! Address of second block
        vbn2,                           ! VBN of second block
        rfa2: BBLOCK[rfa$c_length];     ! RFA used by add_key

    !
    ! Create second index and copy about a quarter of the entries into it.
    !

    perform(create_index(vbn2, index_block2)); ! Allocate index block

    IF .index_desc [idd$v_varlenidx]
    THEN                    ! variable length keyword storage
        BEGIN
```

```
4               cur_entry = .index_block1 + index$c_entries;
4               last_used = .index_block1 + index$c_entries + .index_block1 [index$w_used];
4               DO
5                   BEGIN
5                   LOCAL
5                       entry_len;              ! length of variable index entry in index block
5                   last_entry = .cur_entry;
5                   entry_len = idx$c_rfaplsbyt + .cur_entry[idx$b_keylen];
5                   cur_entry = .cur_entry + .entry_len;
5                   END
5               UNTIL (.cur_entry + lbr$c_maxkeylen )
4                       GTR (.index_block1 + index$c_blksiz );
4               move_length = .last_used - .last_entry;
4
4
4               index_block1 [index$w_used] =
4                   .index_block1 [index$w_used] - .move_length;
4               index_block2 [index$w_used] = .move_length;
4               CH$MOVE(.move_length,           ! Copy half the block
4                   entry(.index_block1+.index_block1 [index$w_used],0),
4                   entry(.index_block2,0));
4
4               reset_highest2(.index,.index_desc,.vbn1,.index_block1); ! Reset highest key
4               END
3           ELSE                ! fixed length keyword storage
4               BEGIN
4               !
4               !    Move the last fourth of the entries
4               !
5               move_length = (.index_block1 [index$w_used] / .entry_size / 4)  ! ***
4                               * .entry_size;
4               !
4               !    If the keyword size is so large that fewer than four keywords fit
4               !    in an index block, then only move out 1 entry.
4               !
4               IF .move_length EQL 0 THEN move_length = .entry_size;
4               index_block1 [index$w_used] =
4                   .index_block1 [index$w_used] - .move_length;
4               index_block2 [index$w_used] = .move_length;
4               CH$MOVE(.move_length,           ! Copy 3/4 of the block
4                   entry(.index_block1+.index_block1 [index$w_used],0),
4                   entry(.index_block2,0));
4
4               reset_highest(.index_desc,.vbn1,.index_block1); ! Reset highest key
3               END;
3
3           IF .index_block1 [index$l_parent] EQL 0 ! If at top of tree already,
3           THEN
4               BEGIN
4               !
4               ! Create a parent block for the 2 index blocks.
4               !
4               LOCAL
4                   index_block0: REF BBLOCK,   ! Address of parent block
4                   vbn0;                       ! VBN of parent block
4
4               perform(create_index(vbn0, index_block0)); ! Create parent
```

```

            index_block0 [index$l_parent] = .index_block1 [index$l_parent];
            index_block1 [index$l_parent] = .vbn0;
            IF .index_block0 [index$l_parent] EQL 0 ! If root of tree
            THEN
                index_desc [idd$l_vbn] = .vbn0;      ! Reset root pointer

            IF .index_desc [idd$v_varlenidx]
            THEN
                perform( add_index2(.index, .vbn1, .index_block1) )
            ELSE
                perform( add_index(.index, .vbn1, .index_block1) );
                                                ! Add highest key to parent
            END;

        index_block2 [index$l_parent] = .index_block1 [index$l_parent];

        IF .index_desc [idd$v_varlenidx]
        THEN
            BEGIN
            perform( add_index2(.index, .vbn2, .index_block2) );! Add key to parent
            !
            !       If any of the entries which were moved into the second
            !       block pointed to sub-indices, reset the parent backpointer
            !       in that sub-index to point to the second block (vbn2).
            !
            ptr = .index_block2 + index$c_entries;
            last_used = .index_block2+ index$c_entries +.index_block2[index$w_used];
            WHILE .ptr LSS .last_used DO
                BEGIN
                MAP
                    ptr: REF BBLOCK;                ! Address index entry
                IF .ptr [idx$w_offset] EQL rfa$c_index ! If points to index,
                THEN
                    BEGIN
                    LOCAL block: REF BBLOCK;
                    perform(find_index(.ptr [idx$l_vbn], block));
                    block [index$l_parent] = .vbn2; ! Reset parent block
                    mark_dirty(.ptr [idx$l_vbn]);   ! Mark block dirty
                    END;
                ptr = .ptr + idx$c_rfaplsbyt + .ptr[idx$b_keylen];
                END;
            END
        ELSE
            BEGIN
            perform( add_index(.index, .vbn2, .index_block2) );! Add key to parent
            !
            !       If any of the entries which were moved into the second
            !       block pointed to sub-indices, reset the parent backpointer
            !       in that sub-index to point to the second block (vbn2).
            !
            INCRU ptr FROM .index_block2+index$c_entries
                TO .index_block2+index$c_entries+.index_block2 [index$w_used]-1
                BY .entry_size
            DO
                BEGIN
                MAP
```

```
5                   ptr: REF BBLOCK;                ! Address index entry
5               IF .ptr [idx$w_offset] EQL rfa$c_index ! If points to index,
5               THEN
6                   BEGIN
6                   LOCAL block: REF BBLOCK;
6                   perform(find_index(.ptr [idx$l_vbn], block));
6                   block [index$l_parent] = .vbn2; ! Reset parent block
6                   mark_dirty(.ptr [idx$l_vbn]);   ! Mark block dirty
5                   END;
4               END;
3           END;
3   !
3   !       If the add position was in the second half of the
3   !       split block, then reset index_block1 and vbn1 so
3   !       that the following code adds the key to the second
3   !       block.  In addition, if we are adding a subindex key,
3   !       then adjust the parent block of that subindex to point
3   !       to this newly split second block rather than the original
3   !       first block.  Adjust the add offset for the second block.
3   !
3       IF .addpos GTRU .index_block1 [index$w_used] ! If in 2nd half,
3       THEN
4           BEGIN
4           IF .key_rfa [rfa$w_offset] EQL rfa$c_index ! If index pointer,
4           THEN
5               BEGIN
5               LOCAL block: REF BBLOCK;
5               perform(find_index(.key_rfa [rfa$l_vbn], block));
5               block [index$l_parent] = .vbn2;     ! Reset parent block
5               mark_dirty(.key_rfa [rfa$l_vbn]);   ! Mark block modified
4               END;
4
4           mark_dirty(.vbn1);                  ! Mark block 1 modified now
4                                               ! since 2 will be marked below
4           addpos = .addpos - .index_block1 [index$w_used]; ! Adjust offset
4           index_block1 = .index_block2;    ! Add key to second block
4           vbn1 = .vbn2;
3           END;
3
2       END;
2   !
2   !       Make room for new entry by pushing all
2   !       the following entries in use down one.
2   !
2   CH$MOVE(.index_block1 [index$w_used] - .addpos,
2       entry(.index_block1+.addpos,0),
2       entry(.index_block1+.addpos+.entry_size,0));
2   index_block1 [index$w_used] = .index_block1 [index$w_used]+.entry_size;
2   !
2   !       Add the key to the index
2   !
2   entry(.index_block1+.addpos,idx$l_vbn) = .key_rfa [rfa$l_vbn];
2   entry(.index_block1+.addpos,idx$w_offset) = .key_rfa [rfa$w_offset];
2
2   IF .index_desc [idd$v_ascii]            ! If ASCII keys,
2   THEN
3       BEGIN
```

```
; 1036        1847  3         !
; 1037        1848  3         !    If keywords in this index are to be upper cased for
; 1038        1849  3         !    entry then upcase.
; 1039        1850  3         !
; 1040        1851  3         IF NOT .index_desc [idd$v_nocasentr]
; 1041        1852  3         THEN perform (make_upper_case (.key_desc, .key_desc, true));
; 1042        1853  3
; 1043        1854  3         CH$MOVE(.key_desc [dsc$w_length],   ! Copy ASCII key
; 1044        1855  3              .key_desc [dsc$a_pointer],
; 1045        1856  3              entry(.index_block1+.addpos,idx$t_keyname));
; 1046        1857  3         entry(.index_block1+.addpos,idx$b_keylen) =
; 1047        1858  3              .key_desc [dsc$w_length];
; 1048        1859  3         END
; 1049        1860  2     ELSE                                    ! If binary keys,
; 1050        1861  2         entry(.index_block1+.addpos,idx$l_keyid) =
; 1051        1862  2              ..key_desc;
; 1052        1863  2     !
; 1053        1864  2     !        Mark index block modified to be written back later.
; 1054        1865  2     !
; 1055        1866  2     mark_dirty(.vbn1);                ! Mark index block modified
; 1056        1867  2     !
; 1057        1868  2     !        Reset highest keys in parent index blocks.
; 1058        1869  2     !
; 1059        1870  2     IF .addpos+.entry_size EQL .index_block1 [index$w_used]
; 1060        1871  2     THEN
; 1061        1872  2         IF .index_desc[idd$v_varlenidx] !   If index block has variable length keys
; 1062        1873  2         THEN
; 1063        1874  3              perform( reset_highest2 (.index, .index_desc, .vbn1, .index_block1))
; 1064        1875  2         ELSE
; 1065        1876  2              perform( reset_highest (.index_desc, .vbn1, .index_block1) );
; 1066        1877  2
; 1067        1878  2     !
; 1068        1879  2     ! Unless the entry points to an index, update the index entry total
; 1069        1880  2     !
; 1070        1881  3     BEGIN
; 1071        1882  3         BIND
; 1072        1883  3              header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
; 1073        1884  3
; 1074        1885  3         IF .key_rfa[rfa$w_offset] NEQ rfa$c_index
; 1075        1886  4         THEN BEGIN
; 1076        1887  4              header[lhd$l_idxcnt] = .header[lhd$l_idxcnt] + 1;
; 1077        1888  4
; 1078        1889  4              IF .index EQL 1                    ! If index 1
; 1079        1890  4                  THEN header[lhd$l_modcnt] = .header[lhd$l_modcnt] + 1;
; 1080        1891  4              END
; 1081        1892  3            ELSE header [lhd$l_idxovh] = .header [lhd$l_idxovh] + 1; ! Count overhead block
; 1082        1893  2     END;
; 1083        1894  2
; 1084        1895  2     RETURN true;
; 1085        1896  1     END;



                                                   0FFC 00000          .ENTRY  ADD_KEY, Save R2,R3,R4,R5,R6,R7,R8,R9,R10,- ; 1563
                                                                               R11                                          ;
```

```
                                                               N 1
LBR_INDEX                                             16-Sep-1984 01:56:12    VAX-11 Bliss-32 V4.0-742                    Page  35
V04-000           add_key                             14-Sep-1984 12:37:41    DISK$VMSMASTER:[LBR.SRC]INDEX.B32;1          (13)

                         5E                  3C  C2 00002              SUBL2   #60, SP                              :
                         50         0000G    CF  D0 00005              MOVL    LBR$GL_CONTROL, R0                   : 1607
                         5B            04    AC  D0 0000A              MOVL    INDEX, R11                           : 1608
                         58         0A B04B  7E  0000E                 MOVAQ   @10(R0)[R11], INDEX_DESC             :
                         58          00BC    C8  9E 00013              MOVAB   188(R8), INDEX_DESC                  :
                         5A            08    AC  D0 00018              MOVL    KEY_DESC, R10                        : 1612
                                             52  D4 0001C              CLRL    R2                                   :
                         51                  5A  D0 0001E              MOVL    R10, R1                              :
                         50                  5A  D0 00021              MOVL    R10, R0                              :
                                          0000G  30 00024              BSBW    MAKE_UPPER_CASE                      :
                         25                  50  E9 00027              BLBC    STATUS, 3$                           :
                         12                  68  E9 0002A              BLBC    (INDEX_DESC), 2$                     : 1616
                  02     A8                  6A  B1 0002D              CMPW    (R10), 2(INDEX_DESC)                 : 1618
                                             04  1A 00031              BGTRU   1$                                   :
                                             6A  B5 00033              TSTW    (R10)                                : 1619
                                             08  12 00035              BNEQ    2$                                   :
                         50 00000000G        8F  D0 00037 1$:          MOVL    #LBR$_INVKEY, R0                     : 1621
                                                 04 0003E              RET                                          :
                                       04    A8  D5 0003F 2$:          TSTL    4(INDEX_DESC)                        : 1625
                                             1A  12 00042              BNEQ    4$                                   :
                                       10    AE  9F 00044              PUSHAB  INDEX_BLOCK1                         : 1628
                                       18    AE  9F 00047              PUSHAB  VBN1                                 :
                0000V    CF                  02  FB 0004A              CALLS   #2, CREATE_INDEX                     :
                         72                  50  E9 0004F 3$:          BLBC    STATUS, 11$                          :
                  04     A8            14    AE  D0 00052              MOVL    VBN1, 4(INDEX_DESC)                  : 1629
                         50            10    AE  D0 00057              MOVL    INDEX_BLOCK1, R0                     : 1630
                                       02    A0  D4 0005B              CLRL    2(R0)                                :
                                       08    AE  9F 0005E 4$:          PUSHAB  ADDPOS                               : 1635
                                       10    AE  9F 00061              PUSHAB  GENPOS                               :
                                       18    AE  9F 00064              PUSHAB  INDEX_BLOCK1                         :
                                       20    AE  9F 00067              PUSHAB  VBN1                                 :
                         04                  6C  91 0006A              CMPB    (AP), #4                             : 1636
                                             0A  1F 0006D              BLSSU   5$                                   :
                                       10    AC  D5 0006F              TSTL    16(AP)                               :
                                             05  13 00072              BEQL    5$                                   :
                                       10    AC  DD 00074              PUSHL   STOP_VBN                             :
                                             02  11 00077              BRB     6$                                   :
                                             7E  D4 00079 5$:          CLRL    -(SP)                                :
                                             5A  DD 0007B 6$:          PUSHL   R10                                  : 1635
                                             5B  DD 0007D              PUSHL   R11                                  :
                0000V    CF                  07  FB 0007F              CALLS   #7, FIND_KEY                         :
                         08                  50  E9 00084              BLBC    STATUS, 7$                           : 1641
                         50 00000000G        8F  D0 00087              MOVL    #LBR$_DUPKEY, R0                     : 1643
                                                 04 0008E              RET                                          :
       08                68                  02  E1 0008F 7$:          BBC     #2, (INDEX_DESC), 8$                 : 1648
                         6E                  6A  3C 00093              MOVZWL  (R10), ENTRY_SIZE                    : 1650
                         6E                  07  C0 00096              ADDL2   #7, ENTRY_SIZE                       :
                                             07  11 00099              BRB     9$                                   :
                         6E            02    A8  3C 0009B 8$:          MOVZWL  2(INDEX_DESC), ENTRY_SIZE            : 1652
                         6E                  06  C0 0009F              ADDL2   #6, ENTRY_SIZE                       :
                         56            10    AE  D0 000A2 9$:          MOVL    INDEX_BLOCK1, R6                     : 1654
                         52                  66  3C 000A6              MOVZWL  (R6), R2                             :
       50                52                  6E  C1 000A9              ADDL3   ENTRY_SIZE, R2, R0                   :
           000001F4      8F                  50  D1 000AD              CMPL    R0, #500                             :
                                             03  1A 000B4              BGTRU   10$                                  :
                                          01BE   31 000B6              BRW     33$                                  :
                                       18    AE  9F 000B9 10$:         PUSHAB  INDEX_BLOCK2                         : 1671
```

```
                                     20   AE  9F 000BC          PUSHAB  VBN2                                  :
                     0000V  CF            02  FB 000BF          CALLS   #2, CREATE_INDEX                      :
                            01            50  E8 000C4  11$:    BLBS    STATUS, 12$                           :
                                              04 000C7          RET                                           :
                            57     18     AE  D0 000C8  12$:    MOVL    INDEX_BLOCK2, R7                      : 1693
                            59     14     AE  D0 000CC          MOVL    VBN1, R9                              : 1698
             49             68            02  E1 000D0          BBC     #2, (INDEX_DESC), 14$                 :
                            50     0C     A6  9E 000D4          MOVAB   12(R6), CUR_ENTRY                     : 1676
                     04     AE     0C   A246  9E 000D8          MOVAB   12(R2)[R6], LAST_USED                 : 1677
                            52   01F4     C6  9E 000DE          MOVAB   500(R6), R2                           : 1687
                            53            50  D0 000E3  13$:    MOVL    CUR_ENTRY, LAST_ENTRY                 : 1682
                            51     06     A0  9A 000E6          MOVZBL  6(CUR_ENTRY), ENTRY_LEN               : 1683
                            51            07  C0 000EA          ADDL2   #7, ENTRY_LEN                         :
                            50            51  C0 000ED          ADDL2   ENTRY_LEN, CUR_ENTRY                  : 1684
                            51   0080     C0  9E 000F0          MOVAB   128(R0), R1                           : 1686
                            52            51  D1 000F5          CMPL    R1, R2                                : 1687
                                          E9  15 000F8          BLEQ    13$                                   :
             51      04     AE            53  C3 000FA          SUBL3   LAST_ENTRY, LAST_USED, MOVE_LENGTH    : 1688
                            66            51  A2 000FF          SUBW2   MOVE_LENGTH, (R6)                     : 1692
                            67            51  B0 00102          MOVW    MOVE_LENGTH, (R7)                     : 1693
                            50            66  3C 00105          MOVZWL  (R6), R0                              : 1695
       0C    A7      0C   A046            51  28 00108          MOVC3   MOVE_LENGTH, 12(R0)[R6], 12(R7)       : 1696
                                          56  DD 0010F          PUSHL   R6                                    : 1698
                            7E            58  7D 00111          MOVQ    INDEX_DESC, -(SP)                     :
                                          5B  DD 00114          PUSHL   R11                                   :
                     0000V  CF            04  FB 00116          CALLS   #4, RESET_HIGHEST2                    :
                                          29  11 0011B          BRB     16$                                   : 1673
                            52            6E  C6 0011D  14$:    DIVL2   ENTRY_SIZE, R2                        : 1705
                            52            04  C6 00120          DIVL2   #4, R2                                :
             51             52            6E  C5 00123          MULL3   ENTRY_SIZE, R2, MOVE_LENGTH           : 1706
                                          03  12 00127          BNEQ    15$                                   : 1711
                            51            6E  D0 00129          MOVL    ENTRY_SIZE, MOVE_LENGTH               :
                            66            51  A2 0012C  15$:    SUBW2   MOVE_LENGTH, (R6)                     : 1713
                            67            51  B0 0012F          MOVW    MOVE_LENGTH, (R7)                     : 1714
                            50            66  3C 00132          MOVZWL  (R6), R0                              : 1716
       0C    A7      0C   A046            51  28 00135          MOVC3   MOVE_LENGTH, 12(R0)[R6], 12(R7)       : 1717
                                          56  DD 0013C          PUSHL   R6                                    : 1719
                            7E            58  7D 0013E          MOVQ    INDEX_DESC, -(SP)                     :
                     0000V  CF            03  FB 00141          CALLS   #3, RESET_HIGHEST                     :
                                   02     A6  D5 00146  16$:    TSTL    2(R6)                                 : 1722
                                          45  12 00149          BNEQ    20$                                   :
                                   20     AE  9F 0014B          PUSHAB  INDEX_BLOCK0                          : 1732
                                   28     AE  9F 0014E          PUSHAB  VBN0                                  :
                     0000V  CF            02  FB 00151          CALLS   #2, CREATE_INDEX                      :
                            77            50  E9 00156          BLBC    STATUS, 22$                           :
                            50     20     AE  D0 00159          MOVL    INDEX_BLOCK0, R0                      : 1734
                     02     A0     02     A6  D0 0015D          MOVL    2(R6), 2(R0)                          :
                     02     A6     24     AE  D0 00162          MOVL    VBN0, 2(R6)                           : 1735
                                   02     A0  D5 00167          TSTL    2(R0)                                 : 1736
                                          05  12 0016A          BNEQ    17$                                   :
                     04     A8     24     AE  D0 0016C          MOVL    VBN0, 4(INDEX_DESC)                   : 1738
             0D             68            02  E1 00171  17$:    BBC     #2, (INDEX_DESC), 18$                 : 1740
                                          56  DD 00175          PUSHL   R6                                    : 1742
                                          59  DD 00177          PUSHL   R9                                    :
                                          5B  DD 00179          PUSHL   R11                                   :
                     0000V  CF            03  FB 0017B          CALLS   #3, ADD_INDEX2                        :
                                          0B  11 00180          BRB     19$                                   :
```

```
                                         56  DD 00182 18$:   PUSHL   R6                              ; 1744
                                         59  DD 00184        PUSHL   R9                              ;
                                         5B  DD 00186        PUSHL   R11                             ;
                      0000V  CF          03  FB 00188        CALLS   #3, ADD_INDEX                   ;
                             67          50  E9 0018D 19$:   BLBC    STATUS, 25$                     ;
                         02  A7      02  A6  D0 00190 20$:   MOVL    2(R6), 2(R7)                    ; 1748
                             53      1C  AE  D0 00195        MOVL    VBN2, R3                        ; 1753
              4F             68          02  E1 00199        BBC     #2, (INDEX_DESC), 24$           ; 1750
                                   0088  8F  BB 0019D        PUSHR   #^M<R3,R7>                      ; 1753
                                         5B  DD 001A1        PUSHL   R11                             ;
                      0000V  CF          03  FB 001A3        CALLS   #3, ADD_INDEX2                  ;
                             6F          50  E9 001A8        BLBC    STATUS, 27$                     ;
                             52      0C  A7  9E 001AB        MOVAB   12(R7), PTR                     ; 1759
                             50          67  3C 001AF        MOVZWL  (R7), R0                        ; 1760
                         04  AE    0C A047  9E 001B2        MOVAB   12(R0)[R7], LAST_USED           ;
                         04  AE          52  D1 001B8 21$:   CMPL    PTR, LAST_USED                  ; 1761
                                         75  18 001BC        BGEQ    30$                             ;
                       FFFF  8F      04  A2  B1 001BE        CMPW    4(PTR), #65535                  ; 1765
                                         1B  12 001C4        BNEQ    23$                             ;
                             51      28  AE  9E 001C6        MOVAB   BLOCK, R1                       ; 1769
                             50          62  D0 001CA        MOVL    (PTR), R0                       ;
                                      0000V  30 001CD        BSBW    FIND_INDEX                      ;
                             7E          50  E9 001D0 22$:   BLBC    STATUS, 31$                     ;
                             50      28  AE  D0 001D3        MOVL    BLOCK, R0                       ; 1770
                         02  A0          53  D0 001D7        MOVL    R3, 2(R0)                       ;
                             50          62  D0 001DB        MOVL    (PTR), R0                       ; 1771
                                      0000V  30 001DE        BSBW    MARK_DIRTY                      ;
                             50      06  A2  9A 001E1 23$:   MOVZBL  6(PTR), R0                      ; 1773
                             52    07 A042  9E 001E5        MOVAB   7(R0)[PTR], PTR                 ;
                                         CC  11 001EA        BRB     21$                             ; 1761
                                   0088  8F  BB 001EC 24$:   PUSHR   #^M<R3,R7>                      ; 1778
                                         5B  DD 001F0        PUSHL   R11                             ;
                      0000V  CF          03  FB 001F2        CALLS   #3, ADD_INDEX                   ;
                             57          50  E9 001F7 25$:   BLBC    STATUS, 31$                     ;
                             52      0C  A7  9E 001FA        MOVAB   12(R7), R2                      ; 1784
                             50          67  3C 001FE        MOVZWL  (R7), R0                        ; 1785
                             54    0B A047  9E 00201        MOVAB   11(R0)[R7], R4                  ;
                                         26  11 00206        BRB     29$                             ; 1786
                       FFFF  8F      04  A2  B1 00208 26$:   CMPW    4(PTR), #65535                  ; 1791
                                         1B  12 0020E        BNEQ    28$                             ;
                             51      2C  AE  9E 00210        MOVAB   BLOCK, R1                       ; 1795
                             50          62  D0 00214        MOVL    (PTR), R0                       ;
                                      0000V  30 00217        BSBW    FIND_INDEX                      ;
                             34          50  E9 0021A 27$:   BLBC    STATUS, 31$                     ;
                             50      2C  AE  D0 0021D        MOVL    BLOCK, R0                       ; 1796
                         02  A0          53  D0 00221        MOVL    R3, 2(R0)                       ;
                             50          62  D0 00225        MOVL    (PTR), R0                       ; 1797
                                      0000V  30 00228        BSBW    MARK_DIRTY                      ;
                             52          6E  C0 0022B 28$:   ADDL2   ENTRY_SIZE, PTR                 ; 1784
                             54          52  D1 0022E 29$:   CMPL    PTR, R4                         ;
                                         D5  1B 00231        BLEQU   26$                             ;
  08   AE     66             10          00  ED 00233 30$:   CMPZV   #0, #16, (R6), ADDPOS           ; 1810
                                         3C  1E 00239        BGEQU   33$                             ;
                             52      0C  AC  D0 0023B        MOVL    KEY_RFA, R2                     ; 1813
                       FFFF  8F      04  A2  B1 0023F        CMPW    4(R2), #65535                   ;
                                         1B  12 00245        BNEQ    32$                             ;
                             51      30  AE  9E 00247        MOVAB   BLOCK, R1                       ; 1817
```

```
                                                    D  2
LBR_INDEX                                       16-Sep-1984 01:56:12    VAX-11 Bliss-32 V4.0-742             Page  38
V04-000         add_key                         14-Sep-1984 12:37:41    DISK$VMSMASTER:[LBR.SRC]INDEX.B32;1     (13)

                        50           62  D0 0024B          MOVL    (R2), R0                           ;
                                  0000V  30 0024E          BSBW    FIND_INDEX                         ;
                        60           50  E9 00251  31$:    BLBC    STATUS, 34$                        ;
                        50      30   AE  D0 00254          MOVL    BLOCK, R0                          ; 1818
                   02   A0           53  D0 00258          MOVL    R3, 2(R0)                          ;
                        50           62  D0 0025C          MOVL    (R2), R0                           ; 1819
                                  0000V  30 0025F          BSBW    MARK_DIRTY                         ;
                        50           59  D0 00262  32$:    MOVL    R9, R0                             ; 1822
                                  0000V  30 00265          BSBW    MARK_DIRTY                         ;
                        50           66  3C 00268          MOVZWL  (R6), R0                           ; 1824
                   08   AE           50  C2 0026B          SUBL2   R0, ADDPOS                         ;
                   10   AE           57  D0 0026F          MOVL    R7, INDEX_BLOCK1                   ; 1825
                   14   AE           53  D0 00273          MOVL    R3, VBN1                           ; 1826
                        59      10   AE  D0 00277  33$:    MOVL    INDEX_BLOCK1, R9                   ; 1834
                        50           69  3C 0027B          MOVZWL  (R9), R0                           ;
                        50      08   AE  C2 0027E          SUBL2   ADDPOS, R0                         ;
              57        59      08   AE  C1 00282          ADDL3   ADDPOS, R9, R7                     ; 1835
              56        6E           0C  C1 00287          ADDL3   #12, ENTRY_SIZE, R6                ; 1836
            6647   0C   A7           50  28 0028B          MOVC3   R0, 12(R7), (R6)[R7]               ;
                        69           6E  A0 00291          ADDW2   ENTRY_SIZE, (R9)                   ; 1837
                        56      0C   AC  D0 00294          MOVL    KEY_RFA, R6                        ; 1841
                   0C   A7           66  D0 00298          MOVL    (R6), 12(R7)                       ;
                   10   A7      04   A6  B0 0029C          MOVW    4(R6), 16(R7)                      ; 1842
                        1F           68  E9 002A1          BLBC    (INDEX_DESC), 36$                  ; 1844
              0F        68           04  E0 002A4          BBS     #4, (INDEX_DESC), 35$              ; 1851
                        52           01  D0 002A8          MOVL    #1, R2                             ; 1852
                        51           5A  D0 002AB          MOVL    R10, R1                            ;
                        50           5A  D0 002AE          MOVL    R10, R0                            ;
                                  0000G  30 002B1          BSBW    MAKE_UPPER_CASE                    ;
                        6A           50  E9 002B4  34$:    BLBC    STATUS, 43$                        ;
          13  A7   04   BA           6A  28 002B7  35$:    MOVC3   (R10), @4(R10), 19(R7)             ; 1856
                   12   A7           6A  90 002BD          MOVB    (R10), 18(R7)                      ; 1858
                                     04  11 002C1          BRB     37$                                ; 1844
                   12   A7           6A  D0 002C3  36$:    MOVL    (R10), 18(R7)                      ; 1862
                        50      14   AE  D0 002C7  37$:    MOVL    VBN1, R0                           ; 1866
                                  0000V  30 002CB          BSBW    MARK_DIRTY                         ;
              50   08   AE           6E  C1 002CE          ADDL3   ENTRY_SIZE, ADDPOS, R0             ; 1870
      50      69        10           00  ED 002D3          CMPZV   #0, #16, (R9), R0                  ;
                                     23  12 002D8          BNEQ    40$                                ;
              10        68           02  E1 002DA          BBC     #2, (INDEX_DESC), 38$              ; 1872
                                     59  DD 002DE          PUSHL   R9                                 ; 1874
                                18   AE  DD 002E0          PUSHL   VBN1                               ;
                                     58  DD 002E3          PUSHL   INDEX_DESC                         ;
                                     5B  DD 002E5          PUSHL   R11                                ;
                0000V   CF           04  FB 002E7          CALLS   #4, RESET_HIGHEST2                 ;
                                     0C  11 002EC          BRB     39$                                ;
                                     59  DD 002EE  38$:    PUSHL   R9                                 ; 1876
                                18   AE  DD 002F0          PUSHL   VBN1                               ;
                                     58  DD 002F3          PUSHL   INDEX_DESC                         ;
                0000V   CF           03  FB 002F5          CALLS   #3, RESET_HIGHEST                  ;
                        24           50  E9 002FA  39$:    BLBC    STATUS, 43$                        ;
                        50   0000G   CF  D0 002FD  40$:    MOVL    LBR$GL_CONTROL, R0                 ; 1883
                        50      0A   A0  D0 00302          MOVL    10(R0), R0                         ;
                 FFFF   8F      04   A6  B1 00306          CMPW    4(R6), #65535                      ; 1885
                                     0D  13 0030C          BEQL    41$                                ;
                                6A   A0  D6 0030E          INCL    106(R0)                            ; 1887
                        01           5B  D1 00311          CMPL    R11, #1                            ; 1889
```

```
                                      08   12 00314         BNEQ    42$                                    ;
                               6E     A0   D6 00316         INCL    110(R0)                                ; 1890
                                      03   11 00319         BRB     42$                                    ; 1885
                               78     A0   D6 0031B 41$:    INCL    120(R0)                                ; 1892
                        50            01   D0 0031E 42$:    MOVL    #1, R0                                 ; 1895
                                           04 00321 43$:    RET                                            ; 1896

; Routine Size:  802 bytes,    Routine Base:  $CODE$ + 04B0
```

```
  1 %SBTTL  'remove_key';
  1 GLOBAL ROUTINE remove_key (index, key_desc, stop_vbn) =
  1
  1 !---
  1 !
  1 !       Delete a key from a specified primary index.
  1 !
  1 ! Inputs:
  1 !
  1 !       index = Primary index number
  1 !       key_desc = Descriptor of key if ASCII, else binary key.
  1 !       stop_vbn (optional) = VBN of index block containing key.
  1 !
  1 ! Outputs:
  1 !
  1 !       The key is deleted from the index if it axists.
  1 !
  1 !       true            key was found and deleted.
  1 !       lbr$_keynotfnd  key was not found
  1 !---
  1
  2 BEGIN
  2
  2 MAP
  2     key_desc: REF BBLOCK;
  2
  2 LOCAL
  2     index_desc: REF BBLOCK,                 ! Index descriptor
  2     vbn,                                    ! VBN of index block
  2     index_block: REF BBLOCK,                ! Address of index block
  2     entry: REF BBLOCK,                      ! Address key entry
  2     offset,                                 ! Offset to key entry
  2     addpos,                                 ! Offset to add position
  2     index_ptr,                              ! True if deleteing index pointer entry
  2     entry_size;                             ! Size of each entry
  2
  2 BUILTIN
  2     NULLPARAMETER;                  ! True if argument unspecified
  2
  2 !
  2 !       Find the entry describing the key.
  2 !
P 2 perform (find_key (.index, .key_desc,
P 2         (IF NOT NULLPARAMETER(3) THEN .stop_vbn ELSE 0),
  2                 vbn, index_block, offset, addpos));
  2 !
  2 !       Push down all following entries in the block.
  2 !
  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
  2             + (.index-1)*idd$c_length;
  2
  2 IF .index_desc[idd$v_varlenidx] !       If index block has variable length keys
  2 THEN
  2     entry_size = idx$c_rfaplsbyt + .key_desc [dsc$w_length]
  2 ELSE
  2     entry_size = idx$c_length + .index_desc [idd$w_keylen];
  2
```

```
; 1144          1954  2 entry = .index_block + index$c_entries + .offset;
; 1145          1955  2 index_ptr = (.entry[rfa$w_offset] EQL rfa$c_index);
; 1146          1956  2
; 1147          1957  2 index_block [index$w_used] = .index_block [index$w_used] - .entry_size;
; 1148          1958  2 CH$MOVE(.index_block [index$w_used] - .offset,
; 1149          1959  2         .entry+.entry_size,
; 1150          1960  2         .entry);
; 1151          1961  2 !
; 1152          1962  2 !       If the block becomes empty, remove it from the tree.
; 1153          1963  2 !
; 1154          1964  2 IF .index_block [index$w_used] EQL 0
; 1155          1965  2 THEN
; 1156          1966  3     BEGIN
; 1157          1967  3     IF .index_block [index$l_parent] EQL 0      ! If root of tree,
; 1158          1968  3     THEN
; 1159          1969  3         index_desc [idd$l_vbn] = 0      ! Reset tree header
; 1160          1970  3     ELSE
; 1161          1971  3         remove_key(.index,              ! Else, remove parent pointer
; 1162          1972  3             .key_desc, .index_block [index$l_parent]);
; 1163          1973  3     delete_index(.vbn);         ! Deallocate index block
; 1164          1974  3     END
; 1165          1975  2 ELSE
; 1166          1976  3     BEGIN
; 1167          1977  3     mark_dirty(.vbn);           ! Mark block modified
; 1168          1978  3     IF .index_desc[idd$v_varlenidx] !   If index block has variable length keys
; 1169          1979  3     THEN
; 1170          1980  3         reset_highest2(.index, .index_desc, .vbn, .index_block)
; 1171          1981  3     ELSE
; 1172          1982  3         reset_highest(.index_desc, .vbn, .index_block);
; 1173          1983  2     END;
; 1174          1984  2 !
; 1175          1985  2 ! Unless we just removed an index pointer, update index totals in header
; 1176          1986  2 !
; 1177          1987  3 BEGIN
; 1178          1988  3     BIND
; 1179          1989  3         header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
; 1180          1990  3
; 1181          1991  3     IF NOT .index_ptr
; 1182          1992  4     THEN BEGIN
; 1183          1993  4         IF .index EQL 1
; 1184          1994  4             THEN header[lhd$l_modcnt] = .header[lhd$l_modcnt] -1;
; 1185          1995  4         header[lhd$l_idxcnt] = .header[lhd$l_idxcnt] -1;
; 1186          1996  4         END
; 1187          1997  3     ELSE header [lhd$l_idxovh] = .header [lhd$l_idxovh] - 1;
; 1188          1998  2 END;
; 1189          1999  2
; 1190          2000  2 RETURN true;
; 1191          2001  2
; 1192          2002  1 END;



                                          OFFC 00000        .ENTRY   REMOVE_KEY, Save R2,R3,R4,R5,R6,R7,R8,R9,-   ; 1898
                                                                     R10,R11                                      ;
                              5E        10  C2 00002        SUBL2    #16, SP                                      ;
```

```
                                                   H  2
LBR_INDEX                                          16-Sep-1984 01:56:12    VAX-11 Bliss-32 V4.0-742               Page  42
V04-000         remove_key                         14-Sep-1984 12:37:41    DISK$VMSMASTER:[LBR.SRC]INDEX.B32;1     (14)

                               5E DD 00005        PUSHL   SP                                          ; 1941
                          08   AE 9F 00007        PUSHAB  OFFSET                                      ;
                          10   AE 9F 0000A        PUSHAB  INDEX_BLOCK                                 ;
                          18   AE 9F 0000D        PUSHAB  VBN                                         ;
                  03           6C 91 00010        CMPB    (AP), #3                                    ;
                               0A 1F 00013        BLSSU   1$                                          ;
                          0C   AC D5 00015        TSTL    12(AP)                                      ;
                               05 13 00018        BEQL    1$                                          ;
                          0C   AC DD 0001A        PUSHL   STOP_VBN                                    ;
                               02 11 0001D        BRB     2$                                          ;
                               7E D4 0001F 1$:    CLRL    -(SP)                                       ;
                          08   AC DD 00021 2$:    PUSHL   KEY_DESC                                    ;
                  58      04   AC D0 00024        MOVL    INDEX, R8                                   ;
                               58 DD 00028        PUSHL   R8                                          ;
        0000V     CF           07 FB 0002A        CALLS   #7, FIND_KEY                                ;
                  01           50 E8 0002F        BLBS    STATUS, 3$                                  ;
                                  04 00032        RET                                                 ;
                  50   0000G   CF D0 00033 3$:    MOVL    LBR$GL_CONTROL, R0                          ; 1945
                  57      0A B048 7E 00038        MOVAQ   @10(R0)[R8], INDEX_DESC                     ; 1946
                  57    00BC   C7 9E 0003D        MOVAB   188(R7), INDEX_DESC                         ;
09                67           02 E1 00042        BBC     #2, (INDEX_DESC), 4$                        ; 1948
                  52      08   BC 3C 00046        MOVZWL  @KEY_DESC, ENTRY_SIZE                       ; 1950
                  52           07 C0 0004A        ADDL2   #7, ENTRY_SIZE                              ;
                               07 11 0004D        BRB     5$                                          ;
                  52      02   A7 3C 0004F 4$:    MOVZWL  2(INDEX_DESC), ENTRY_SIZE                   ; 1952
                  52           06 C0 00053        ADDL2   #6, ENTRY_SIZE                              ;
                  56      08   AE D0 00056 5$:    MOVL    INDEX_BLOCK, R6                             ; 1954
50                56      04   AE C1 0005A        ADDL3   OFFSET, R6, R0                              ;
                  50           0C C0 0005F        ADDL2   #12, ENTRY                                  ;
                               51 D4 00062        CLRL    R1                                          ; 1955
        FFFF      8F      04   A0 B1 00064        CMPW    4(ENTRY), #65535                            ;
                               02 12 0006A        BNEQ    6$                                          ;
                               51 D6 0006C        INCL    R1                                          ;
                  59           51 D0 0006E 6$:    MOVL    R1, INDEX_PTR                               ;
                  66           52 A2 00071        SUBW2   ENTRY_SIZE, (R6)                            ; 1957
                  51           66 3C 00074        MOVZWL  (R6), R1                                    ; 1958
                  51      04   AE C2 00077        SUBL2   OFFSET, R1                                  ;
60              6240           51 28 0007B        MOVC3   R1, (ENTRY_SIZE)[ENTRY], (ENTRY)            ; 1960
                               66 B5 00080        TSTW    (R6)                                        ; 1964
                               21 12 00082        BNEQ    9$                                          ;
                          02   A6 D5 00084        TSTL    2(R6)                                       ; 1967
                               05 12 00087        BNEQ    7$                                          ;
                          04   A7 D4 00089        CLRL    4(INDEX_DESC)                               ; 1969
                               0D 11 0008C        BRB     8$                                          ;
                          02   A6 DD 0008E 7$:    PUSHL   2(R6)                                       ; 1972
                          08   AC DD 00091        PUSHL   KEY_DESC                                    ;
                               58 DD 00094        PUSHL   R8                                          ; 1971
        FF65      CF           03 FB 00096        CALLS   #3, REMOVE_KEY                              ;
                          0C   AE DD 0009B 8$:    PUSHL   VBN                                         ; 1973
        0000V     CF           01 FB 0009E        CALLS   #1, DELETE_INDEX                            ;
                               27 11 000A3        BRB     11$                                         ; 1964
                  50      0C   AE D0 000A5 9$:    MOVL    VBN, R0                                     ; 1977
                            0000V 30 000A9        BSBW    MARK_DIRTY                                  ;
10                67           02 E1 000AC        BBC     #2, (INDEX_DESC), 10$                       ; 1978
                               56 DD 000B0        PUSHL   R6                                          ; 1980
                          10   AE DD 000B2        PUSHL   VBN                                         ;
                               57 DD 000B5        PUSHL   INDEX_DESC                                  ;
```

```
LBR_INDEX                                                          16-Sep-1984 01:56:12    VAX-11 Bliss-32 V4.0-742                    Page  43
V04-000          remove_key                                        14-Sep-1984 12:37:41    DISK$VMSMASTER:[LBR.SRC]INDEX.B32;1          (14)

                                        58  DD 000B7                PUSHL   R8                                              ;
                        0000V  CF              04  FB 000B9                CALLS   #4, RESET_HIGHEST2                              ;
                                        0C  11 000BE                BRB     11$                                             ;
                                        56  DD 000C0  10$:          PUSHL   R6                                              ; 1982
                                  10    AE  DD 000C2                PUSHL   VBN                                             ;
                                        57  DD 000C5                PUSHL   INDEX_DESC                                      ;
                        0000V  CF              03  FB 000C7                CALLS   #3, RESET_HIGHEST                               ;
                               50    0000G  CF  D0 000CC  11$:          MOVL    LBR$GL_CONTROL, R0                              ; 1989
                               50       0A  A0  D0 000D1                MOVL    10(R0), R0                                      ;
                               0D           59  E8 000D5                BLBS    INDEX_PTR, 13$                                  ; 1991
                               01           58  D1 000D8                CMPL    R8, #1                                          ; 1993
                                            03  12 000DB                BNEQ    12$                                             ;
                                        6E  A0  D7 000DD                DECL    110(R0)                                         ; 1994
                                        6A  A0  D7 000E0  12$:          DECL    106(R0)                                         ; 1995
                                            03  11 000E3                BRB     14$                                             ; 1991
                                        78  A0  D7 000E5  13$:          DECL    120(R0)                                         ; 1997
                               50           01  D0 000E8  14$:          MOVL    #1, R0                                          ; 2000
                                                04 000EB                RET                                                     ; 2002

; Routine Size:  236 bytes,    Routine Base:  $CODE$ + 07D2
```

```
%SBTTL  'lookup_key';
GLOBAL ROUTINE lookup_key (index, key_desc, retrfa) =

!---
!
!       Look up a given key and return the RFA associated with
!       the key, if found.
!
! Inputs:
!
!       index = Primary index number
!       key_desc = Descriptor of key if ASCII, else binary key.
!       retadr = Longword to receive key entry address.
!       retvbn (optional) = Longword to receive VBN of index block.
!
! Outputs:
!
!       retadr = Address of key entry if found.
!
!       true            if key found
!       lbr$_keynotfnd  if key not found
!
!---

BEGIN

MAP
    retrfa: REF BBLOCK;         ! Address as RFA structure

LOCAL
    vbn,                        ! VBN of index block
    index_block: REF BBLOCK,    ! Address of index block
    offset,                     ! Offset to key entry
    addpos,                     ! Offset to add position
    entry: REF BBLOCK;          ! Address of key entry

BUILTIN
    NULLPARAMETER;              ! True if argument unspecified

perform (find_key (.index, .key_desc, 0,
                vbn, index_block, offset, addpos));

entry = .index_block + index$c_entries + .offset;

IF NOT NULLPARAMETER(3)
THEN BEGIN
    retrfa [rfa$l_vbn] = .entry [idx$l_vbn];
    retrfa [rfa$w_offset] = .entry [idx$w_offset];
    END;

RETURN true;

END;
```

```
                                                  0000 00000          .ENTRY  LOOKUP_KEY, Save nothing              ; 2004
                              5E              10   C2 00002           SUBL2   #16, SP                                ;
                                              5E   DD 00005           PUSHL   SP                                     ; 2043
                                        08    AE   9F 00007           PUSHAB  OFFSET                                 ;
                                        10    AE   9F 0000A           PUSHAB  INDEX_BLOCK                            ;
                                        18    AE   9F 0000D           PUSHAB  VBN                                    ;
                                              7E   D4 00010           CLRL    -(SP)                                  ;
                              7E        04    AC   7D 00012           MOVQ    INDEX, -(SP)                           ;
                       0000V  CF              07   FB 00016           CALLS   #7, FIND_KEY                           ;
                              22              50   E9 0001B           BLBC    STATUS, 2$                             ;
              50        08    AE        04    AE   C1 0001E           ADDL3   OFFSET, INDEX_BLOCK, R0                ; 2045
                              50              0C   C0 00024           ADDL2   #12, ENTRY                             ;
                              03              6C   91 00027           CMPB    (AP), #3                               ; 2047
                                              11   1F 0002A           BLSSU   1$                                     ;
                                        0C    AC   D5 0002C           TSTL    12(AP)                                 ;
                                              0C   13 0002F           BEQL    1$                                     ;
                              51        0C    AC   D0 00031           MOVL    RETRFA, R1                             ; 2049
                              61              60   D0 00035           MOVL    (ENTRY), (R1)                          ;
                        04    A1        04    A0   B0 00038           MOVW    4(ENTRY), 4(R1)                        ; 2050
                              50              01   D0 0003D 1$:       MOVL    #1, R0                                 ; 2053
                                                   04 00040 2$:       RET                                            ; 2055

; Routine Size:  65 bytes,    Routine Base:  $CODE$ + 08BE
```

```
      1 %SBTTL  'traverse_keys';
      1 GLOBAL ROUTINE traverse_keys (index, action_routine, user_routine, rfa) =
      1
      1 !---
      1 !
      1 !       Traverse a specified primary index in key order
      1 !       calling a user action routine for each key.
      1 !
      1 ! Inputs:
      1 !
      1 !       index = Primary index numebr
      1 !       action_routine = Address of internal action routine
      1 !       user_routine = Address of user action routine
      1 !       rfa = RFA to pass to action routine
      1 !
      1 ! Outputs:
      1 !
      1 !       The user routine is called with the following arguments:
      1 !               1) Address of key entry
      1 !
      1 !---
      1
      2 BEGIN
      2
      2 ROUTINE traverse (index_desc, vbn, action_routine, user_routine, txtrfa) =
      3 BEGIN
      3 !
      3 !       Scan all entries in the given index block.
      3 !
      3 MAP
      3     index_desc: REF BBLOCK;      ! Index descriptor
      3
      3 LOCAL
      3     index_block: REF BBLOCK;     ! Index block address
      3
      3 perform (find_index (.vbn, index_block));
      3
      3 INCRU entry FROM .index_block+index$c_entries
      3         TO .index_block+index$c_entries+.index_block[index$w_used]-1
      3         BY idx$c_length + .index_desc [idd$w_keylen]
      3 DO
      4     BEGIN
      4     MAP entry: REF BBLOCK;
      4     IF .entry [idx$w_offset] EQL rfa$c_index    ! If subindex,
      4     THEN
P     4         perform (traverse (.index_desc, .entry [idx$l_vbn],
      5                 .action_routine, .user_routine, .txtrfa))
      4     ELSE
      4         perform((.action_routine)(.entry, .user_routine, .index_desc, .txtrfa));
      3     END;
      3
      3 RETURN true;
      2 END;
```

```
                                         OFFC 00000 TRAVERSE:
                                                          .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11       ; 2080
                  5E          04  C2 00002                SUBL2   #4, SP                                     ;
                  51          6E  9E 00005                MOVAB   INDEX_BLOCK, R1                            ; 2091
                  50    08    AC  D0 00008                MOVL    VBN, R0                                    ;
                           0000V  30 0000C                BSBW    FIND_INDEX                                 ;
                  51          50  E9 0000F                BLBC    STATUS, 5$                                 ;
                  50    00    BE  3C 00012                MOVZWL  @INDEX_BLOCK, R0                           ; 2094
                  50          6E  C0 00016                ADDL2   INDEX_BLOCK, R0                            ;
                  55    0B    A0  9E 00019                MOVAB   11(R0), R5                                 ;
                  53    04    AC  D0 0001D                MOVL    INDEX_DESC, R3                             ; 2095
                  54    02    A3  3C 00021                MOVZWL  2(R3), R4                                  ;
                  54          06  C0 00025                ADDL2   #6, R4                                     ;
         52       6E          0C  C1 00028                ADDL3   #12, INDEX_BLOCK, ENTRY                    ; 2102
                              2D  11 0002C                BRB     4$                                         ;
            FFFF  8F    04    A2  B1 0002E 1$:            CMPW    4(ENTRY), #65535                           ; 2099
                              11  12 00034                BNEQ    2$                                         ;
                  7E    10    AC  7D 00036                MOVQ    USER_ROUTINE, -(SP)                        ; 2102
                        0C    AC  DD 0003A                PUSHL   ACTION_ROUTINE                             ;
                              62  DD 0003D                PUSHL   (ENTRY)                                    ;
                              53  DD 0003F                PUSHL   R3                                         ;
              BB  AF          05  FB 00041                CALLS   #5, TRAVERSE                               ;
                              0E  11 00045                BRB     3$                                         ;
                        14    AC  DD 00047 2$:            PUSHL   TXTRFA                                     ; 2104
                              53  DD 0004A                PUSHL   R3                                         ;
                        10    AC  DD 0004C                PUSHL   USER_ROUTINE                               ;
                              52  DD 0004F                PUSHL   ENTRY                                      ;
              0C  BC          04  FB 00051                CALLS   #4, @ACTION_ROUTINE                        ;
                  0B          50  E9 00055 3$:            BLBC    STATUS, 5$                                 ;
                  52          54  C0 00058                ADDL2   R4, ENTRY                                  ; 2093
                  55          52  D1 0005B 4$:            CMPL    ENTRY, R5                                  ;
                              CE  1B 0005E                BLEQU   1$                                         ;
                  50          01  D0 00060                MOVL    #1, R0                                     ; 2107
                                  04 00063 5$             RET                                                ; 2108

; Routine Size:  100 bytes,    Routine Base:  $CODE$ + 08FF

; 1301         2109  2
; 1302         2110  2  ROUTINE traverse2 (index_desc, vbn, action_routine, user_routine, txtrfa) =
; 1303         2111  3  BEGIN
; 1304         2112  3  !
; 1305         2113  3  !      Traverse2 handles indices with variable length keywords.
; 1306         2114  3  !      Scan all entries in the given index block.
; 1307         2115  3  !
; 1308         2116  3  MAP
; 1309         2117  3      index_desc: REF BBLOCK;       ! Index descriptor
; 1310         2118  3
; 1311         2119  3  LOCAL
; 1312         2120  3      entry,                        ! Traverse each entry in index block
; 1313         2121  3      index_block: REF BBLOCK;      ! Index block address
; 1314         2122  3
; 1315         2123  3  perform (find_index (.vbn, index_block));
; 1316         2124  3
; 1317         2125  3  entry = .index_block+index$c_entries;
; 1318         2126  3  WHILE .entry LSS .index_block+index$c_entries+.index_block[index$w_used]-1 DO
; 1319          2127  4        BEGIN
; 1320          2128  4        MAP entry: REF BBLOCK;
; 1321          2129  4        IF .entry [idx$w_offset] EQL rfa$c_index    ! If subindex,
; 1322          2130  4        THEN
; 1323        P 2131  4            perform (traverse2 (.index_desc, .entry [idx$l_vbn],
; 1324          2132  5                    .action_routine, .user_routine, .txtrfa))
; 1325          2133  4        ELSE
; 1326          2134  4            perform((.action_routine)(.entry, .user_routine, .index_desc, .txtrfa));
; 1327          2135  4        entry = .entry + idx$c_rfaplsbyt + .entry [idx$b_keylen];
; 1328          2136  3        END;
; 1329          2137  3
; 1330          2138  3 RETURN true;
; 1331          2139  2 END;



                                         0FFC 00000 TRAVERSE2:
                                                          .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11                  ; 2110
                         5E          04  C2 00002         SUBL2   #4, SP
                         51          6E  9E 00005         MOVAB   INDEX_BLOCK, R1                                       ; 2123
                         50     08   AC  D0 00008         MOVL    VBN, R0
                              0000V  30 0000C         BSBW    FIND_INDEX
                         4D          50  E9 0000F         BLBC    STATUS, 5$
       52                6E          0C  C1 00012         ADDL3   #12, INDEX_BLOCK, ENTRY                               ; 2125
                         50     00   BE  3C 00016 1$:     MOVZWL  @INDEX_BLOCK, R0                                      ; 2126
                         50          6E  C0 0001A         ADDL2   INDEX_BLOCK, R0
                         50          0B  C0 0001D         ADDL2   #11, R0
                         50          52  D1 00020         CMPL    ENTRY, R0
                                     37  18 00023         BGEQ    4$
                 FFFF    8F     04   A2  B1 00025         CMPW    4(ENTRY), #65535                                      ; 2129
                                     12  12 0002B         BNEQ    2$
                         7E     10   AC  7D 0002D         MOVQ    USER_ROUTINE, -(SP)                                   ; 2132
                                0C   AC  DD 00031         PUSHL   ACTION_ROUTINE
                                     62  DD 00034         PUSHL   (ENTRY)
                                04   AC  DD 00036         PUSHL   INDEX_DESC
                   C3    AF          05  FB 00039         CALLS   #5, TRAVERSE2
                                     0F  11 0003D         BRB     3$
                                14   AC  DD 0003F 2$:     PUSHL   TXTRFA                                                ; 2134
                                04   AC  DD 00042         PUSHL   INDEX_DESC
                                10   AC  DD 00045         PUSHL   USER_ROUTINE
                                     52  DD 00048         PUSHL   ENTRY
                   0C    BC          04  FB 0004A         CALLS   #4, @ACTION_ROUTINE
                         0E          50  E9 0004E 3$:     BLBC    STATUS, 5$
                         50     06   A2  9A 00051         MOVZBL  6(ENTRY), R0                                          ; 2135
                         52     07 A042  [illegible] 00055         MOVAB   7(R0)[ENTRY], ENTRY
                                     BA  11 0005A         BRB     1$                                                    ; 2126
                         50          01  D0 0005C 4$:     MOVL    #1, R0                                                ; 2138
                                         04 0005F 5$:     RET                                                           ; 2139

; Routine Size:  96 bytes,    Routine Base:  $CODE$ + 0963


; 1332          2140  2 !
; 1333          2141  2 !      Main body of traverse_keys procedure
; 1334          2142  2 !
```

```
             2143  2 LOCAL
             2144  2      index_desc: REF BBLOCK;             ! Index descriptor
             2145  2
             2146  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
             2147  2             + (.index-1)*idd$c_length;
             2148  2
             2149  2 IF .index_desc [idd$l_vbn] EQL 0        ! If empty index,
             2150  2 THEN
             2151  2     RETURN true;                        ! return immediately
             2152  2
             2153  2 !
             2154  2 ! Set the lock for the index
             2155  2 !
             2156  2 index_desc [idd$v_locked] = true;
             2157  2
             2158  2 IF .index_desc[idd$v_varlenidx] !       If index block has variable length keys
             2159  2 THEN
           P 2160  2     perform(traverse2(.index_desc, .index_desc [idd$l_vbn],
             2161  3             .action_routine,.user_routine, .rfa))
             2162  2 ELSE
           P 2163  2     perform(traverse(.index_desc, .index_desc [idd$l_vbn],
             2164  2             .action_routine,.user_routine, .rfa));
             2165  2 !
             2166  2 ! Clear the lock
             2167  2 !
             2168  2 index_desc [idd$v_locked] = false;
             2169  2
             2170  2 RETURN true;
             2171  2
             2172  1 END;



                                            0004 00000          .ENTRY  TRAVERSE_KEYS, Save R2                          ; 2057
                     51      0000G   CF   D0 00002          MOVL    LBR$GL_CONTROL, R1                              ; 2146
                     50         04   AC   D0 00007          MOVL    INDEX, R0                                       ; 2147
                     52         0A B140   7E 0000B          MOVAQ   @10(R1)[R0], INDEX_DESC                         ;
                     52       00BC   C2   9E 00010          MOVAB   188(R2), INDEX_DESC                             ;
                                04   A2   D5 00015          TSTL    4(INDEX_DESC)                                   ; 2149
                                     31   13 00018          BEQL    3$                                              ;
                     62              02   88 0001A          BISB2   #2, (INDEX_DESC)                                ; 2156
         13          62              02   E1 0001D          BBC     #2, (INDEX_DESC), 1$                            ; 2158
                     7E         0C   AC   7D 00021          MOVQ    USER_ROUTINE, -(SP)                             ; 2161
                                08   AC   DD 00025          PUSHL   ACTION_ROUTINE                                  ;
                                04   A2   DD 00028          PUSHL   4(INDEX_DESC)                                   ;
                                     52   DD 0002B          PUSHL   INDEX_DESC                                      ;
              FF6E   CF              05   FB 0002D          CALLS   #5, TRAVERSE2                                   ;
                                     11   11 00032          BRB     2$                                              ;
                     7E         0C   AC   7D 00034  1$:     MOVQ    USER_ROUTINE, -(SP)                             ; 2164
                                08   AC   DD 00038          PUSHL   ACTION_ROUTINE                                  ;
                                04   A2   DD 0003B          PUSHL   4(INDEX_DESC)                                   ;
                                     52   DD 0003E          PUSHL   INDEX_DESC                                      ;
              FEF7   CF              05   FB 00040          CALLS   #5, TRAVERSE                                    ;
                     06              50   E9 00045  2$:     BLBC    STATUS, 4$                                      ;
                     62              02   8A 00048          BICB2   #2, (INDEX_DESC)                                ; 2168
```

```
                                   50          01  D0 0004B 3$:     MOVL    #1, R0                                                ; 2170
                                               04  0004E 4$:        RET                                                            ; 2172

; Routine Size:  79 bytes,    Routine Base:  $CODE$ + 09C3
```

```
  1 %SBTTL  'find_key';
  1 GLOBAL ROUTINE find_key (index, key_desc, stop_vbn,
  1                 retvbn, retblkadr, retgenpos, retaddpos) =
  1 !---
  1 !
  1 !       Find a given key and return all information concerning
  1 !       its position within the index tree.  This routine is
  1 !       used solely by routines such as add_key, remove_key,
  1 !       etc. for the common key search processing.
  1 !
  1 ! Inputs:
  1 !
  1 !       index = Primary index number
  1 !       key_desc = Descriptor of key if ASCII, else binary key.
  1 !       stop_vbn = VBN of specific index block, 0 if bottom of tree.
  1 !       retvbn = Longword to receive VBN of index block.
  1 !       retblkadr = Longword to receive address of index block.
  1 !       retgenpos = Longword to receive offset to generic entry.
  1 !       retaddpos = Longword to receive offset to add position.
  1 !
  1 ! Outputs:
  1 !
  1 !       retvbn = VBN of index block.
  1 !       retblkadr = Address of index block.
  1 !       retgenpos = Offset to generically closest key entry.
  1 !       retaddpos = Offset to position to add key.
  1 !
  1 !       true            if key found
  1 !       false           if key not found
  1 !---
  1
  2 BEGIN
  2
  2 MAP
  2     key_desc: REF BBLOCK;                   ! Access as string descriptor
  2
  2 LOCAL
  2     status,
  2     keydesc : BBLOCK [dsc$c_s_bln],
  2     keynambuf : BBLOCK [lbr$c_maxkeylen],
  2     index_desc: REF BBLOCK,                 ! Index descriptor
  2     index_block: REF BBLOCK,                ! Address of index block
  2     vbn,                                    ! VBN of current index block
  2     offset,                                 ! Offset to closest entry
  2     addpos;                                 ! Offset to add position
  2
  2 MACRO
M 2     entry (address,b) =
M 2         (address+index$c_entries+b)
  2         %IF %LENGTH GTR 2 %THEN <%REMAINING> %ELSE <0,0,0> %FI%;
  2
  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
  2             + (.index-1)*idd$c_length;
  2 !
  2 !       Get address of primary index block
  2 !
  2 vbn = .index_desc [idd$l_vbn];                        ! Top of tree
```

```
2 !
2 !       If no primary index block exists yet, key not found.
2 !
2 IF .vbn EQL 0                       ! If no primary index block yet,
2 THEN
2     RETURN lbr$_keynotfnd;          ! Return key not found
2
2 keydesc = 0;
2 keydesc [dsc$w_length] = .key_desc [dsc$w_length];
2 keydesc [dsc$a_pointer] = keynambuf;
2 !
2 !   If keywords in this index are to be upper cased for comparison then upcase
2 !
2 IF NOT .index_desc [idd$v_nocasecmp]
3 THEN perform (make_upper_case (.key_desc, keydesc, true))
2 ELSE
3     BEGIN
3     CH$MOVE (.key_desc [dsc$w_length], .key_desc [dsc$a_pointer],
3                 .keydesc [dsc$a_pointer]);
2     END;
2
2 !
2 !       If a specific index VBN was specified, start there
2 !
2 IF .stop_vbn NEQ 0                  ! If specified,
2 THEN
2     vbn = .stop_vbn;                ! then use it
2 !
2 !       Search down the subtree until either the bottom is
2 !       reached or an error is detected.
2 !
3 DO BEGIN
3     !
3     !   Locate the index block to be searched.  It will either
3     !   find the block in the index cache or it will be read
3     !   from disk and cached.
3     !
3     perform(find_index(.vbn, index_block));
3     !
3     !   Search for position of key within index block.
3     !
3     IF .index_desc[idd$v_varlenidx] !   If index block has variable length keys
3     THEN
3         status = key_search2(.index_desc,.index_block,keydesc,
3                         offset, addpos)
3     ELSE
3         status = key_search(.index_desc,.index_block,keydesc,
3                         offset, addpos);
3     !
3     !   If a specific index block was specified, then stop the search.
3     !
3     IF .stop_vbn EQL .vbn                   ! If at specified block,
3     THEN
3         EXITLOOP;                           ! then stop search
3     !
3     !   If the entry found by the binary search points to another
3     !   index, then continue searching using that index.  If it
```

```
; 1480         2287 3       !   points to an actual data record, then we have reached the
; 1481         2288 3       !   bottom of the tree and the search is stopped.
; 1482         2289 3       !
; 1483         2290 3       IF .offset LSS 0                    ! If no closest entry,
; 1484         2291 3           OR .entry(.index_block+.offset,idx$w_offset) NEQ rfa$c_index
; 1485         2292 3       THEN
; 1486         2293 3           EXITLOOP;                       ! Then stop search
; 1487         2294 3
; 1488         2295 3       vbn = .entry(.index_block+.offset,idx$l_vbn); ! Next index
; 1489         2296 3       END
; 1490         2297 3
; 1491         2298 2       UNTIL false;                        ! Loop until EXITLOOP
; 1492         2299 2
; 1493         2300 2   !
; 1494         2301 2   !       Return index block VBN, address and entry offsets.
; 1495         2302 2   !
; 1496         2303 2   .retvbn = .vbn;
; 1497         2304 2   .retblkadr = .index_block;              ! Return block address
; 1498         2305 2   .retgenpos = .offset;                   ! Return offset to entry
; 1499         2306 2   .retaddpos = .addpos;                   ! Return offset to add position
; 1500         2307 2
; 1501         2308 2   IF NOT .status                          ! If key not found,
; 1502         2309 2   THEN
; 1503         2310 2       RETURN lbr$_keynotfnd;              ! Return key not found
; 1504         2311 2
; 1505         2312 2   !
; 1506         2313 2   ! Propagate actual length of actual index string back to caller
; 1507         2314 2   !
; 1508         2315 2   key_desc[dsc$w_length] = .keydesc[dsc$w_length];
; 1509         2316 2   RETURN true;                            ! Return successful
; 1510         2317 2
; 1511         2318 1   END;



                                          0FFC 00000          .ENTRY  FIND_KEY, Save R2,R3,R4,R5,R6,R7,R8,R9,R10,-; 2174
                                                                      R11                                         :
                      5E    FF6C    CE   9E 00002             MOVAB   -148(SP), SP                                 :
                      51    0000G   CF   D0 00007             MOVL    LBR$GL_CONTROL, R1                           : 2224
                      50      04    AC   D0 0000C             MOVL    INDEX, R0                                    : 2225
                      57      0A B140    7E 00010             MOVAQ   @10(R1)[R0], INDEX_DESC                      :
                      57    00BC    C7   9E 00015             MOVAB   188(R7), INDEX_DESC                          :
                      58      04    A7   D0 0001A             MOVL    4(INDEX_DESC), VBN                           : 2229
                                    03   12 0001E             BNEQ    1$                                           : 2233
                                  00A5   31 00020             BRW     8$                                           :
                              F8    AD   D4 00023  1$:        CLRL    KEYDESC                                      : 2237
                      56      08    AC   D0 00026             MOVL    KEY_DESC, R6                                 : 2238
                 F8   AD            66   B0 0002A             MOVW    (R6), KEYDESC                                :
                 FC   AD      0C    AE   9E 0002E             MOVAB   KEYNAMBUF, KEYDESC+4                         : 2239
      11              67            03   E0 00033             BBS     #3, (INDEX_DESC), 2$                         : 2243
                      51      F8    AD   9E 00037             MOVAB   KEYDESC, R1                                  : 2244
                      52            01   D0 0003B             MOVL    #1, R2                                       :
                      50            56   D0 0003E             MOVL    R6, R0                                       :
                                 0000G   30 00041             BSBW    MAKE_UPPER_CASE                              :
                      07            50   E8 00044             BLBS    STATUS, 3$                                   :
```

```
                                          04 00047          RET                                               ;
          FC    BD      04   B6       66  28 00048 2$:      MOVC3   (R6), @4(R6), @KEYDESC+4                  ; 2248
                             52   0C  AC  D0 0004E 3$:      MOVL    STOP_VBN, R2                              ; 2254
                                      03  13 00052          BEQL    4$                                        ;
                             58       52  D0 00054          MOVL    R2, VBN                                   ; 2256
                             51       6E  9E 00057 4$:      MOVAB   INDEX_BLOCK, R1                           ; 2267
                             50       58  D0 0005A          MOVL    VBN, R0                                   ;
                                   0000V  30 0005D          BSBW    FIND_INDEX                                ;
                             74       50  E9 00060          BLBC    STATUS, 10$                               ;
                15           67       02  E1 00063          BBC     #2, (INDEX_DESC), 5$                      ; 2271
                                  04  AE  9F 00067          PUSHAB  ADDPOS                                    ; 2273
                                  0C  AE  9F 0006A          PUSHAB  OFFSET                                    ;
                                  F8  AD  9F 0006D          PUSHAB  KEYDESC                                   ;
                                  0C  AE  DD 00070          PUSHL   INDEX_BLOCK                               ;
                                      57  DD 00073          PUSHL   INDEX_DESC                                ;
                     0000V  CF        05  FB 00075          CALLS   #5, KEY_SEARCH2                           ;
                                      13  11 0007A          BRB     6$                                        ;
                                  04  AE  9F 0007C 5$:      PUSHAB  ADDPOS                                    ; 2276
                                  0C  AE  9F 0007F          PUSHAB  OFFSET                                    ;
                                  F8  AD  9F 00082          PUSHAB  KEYDESC                                   ;
                                  0C  AE  DD 00085          PUSHL   INDEX_BLOCK                               ;
                                      57  DD 00088          PUSHL   INDEX_DESC                                ;
                     0000V  CF        05  FB 0008A          CALLS   #5, KEY_SEARCH                            ;
                             53       50  D0 0008F 6$:      MOVL    R0, STATUS                                ;
                             58       52  D1 00092          CMPL    R2, VBN                                   ; 2281
                                      1C  13 00095          BEQL    7$                                        ;
                             51   08  AE  D0 00097          MOVL    OFFSET, R1                                ; 2290
                                      16  19 0009B          BLSS    7$                                        ;
                50           6E       51  C1 0009D          ADDL3   R1, INDEX_BLOCK, R0                       ; 2291
                     FFFF    8F   10  A0  B1 000A1          CMPW    16(R0), #65535                            ;
                                      0A  12 000A7          BNEQ    7$                                        ;
                50           6E       51  C1 000A9          ADDL3   R1, INDEX_BLOCK, R0                       ; 2295
                             58   0C  A0  D0 000AD          MOVL    12(R0), VBN                               ;
                                      A4  11 000B1          BRB     4$                                        ; 2261
                       10    BC       58  D0 000B3 7$:      MOVL    VBN, @RETVBN                              ; 2303
                       14    BC       6E  D0 000B7          MOVL    INDEX_BLOCK, @RETBLKADR                   ; 2304
                       18    BC   08  AE  D0 000BB          MOVL    OFFSET, @RETGENPOS                        ; 2305
                       1C    BC   04  AE  D0 000C0          MOVL    ADDPOS, @RETADDPOS                        ; 2306
                             08       53  E8 000C5          BLBS    STATUS, 9$                                ; 2308
                             50 00000000G 8F  D0 000C8 8$:  MOVL    #LBR$_KEYNOTFND, R0                       ; 2310
                                          04 000CF          RET                                               ;
                             66   F8  AD  B0 000D0 9$:      MOVW    KEYDESC, (R6)                             ; 2315
                             50       01  D0 000D4          MOVL    #1, R0                                    ; 2316
                                      04 000D7 10$:         RET                                               ; 2318

; Routine Size:  216 bytes,    Routine Base:  $CODE$ + 0A12
```

```
%SBTTL  'key_search';
ROUTINE key_search (index_desc, index_block, key_desc, genpos, addpos) =

!---
!
!       This routine searches a specified index block using a binary
!       search and returns the position (offset) within the block
!       where the key should be added (if not found) or its exact
!       position (if found).
!
!       It is also used to run down the index tree to find a given
!       key by searching each index block and using the key found
!       generically using this routine to get to the next index block
!       to be searched (the child).
!
! Inputs:
!
!       index_desc = Primary index descriptor
!       index_block = Address of the index block
!       key_desc = String descriptor of the key
!       genpos = Longword to receieve offset to the entry which is
!                       most generically close to the key.
!       addpos (optional) = Longword to receieve offset to position
!                       where the key should be added in the block.
!
! Outputs:
!
!       genpos = Offset to generically closest entry.
!       addpos (if specified) = Offset to position to add key.
!
!       Routine value = true if key found, else false.
!---

BEGIN

MAP
    index_desc: REF BBLOCK,                 ! Index descriptor
    index_block:        REF BBLOCK,         ! Address of index block
    key_desc:           REF BBLOCK;         ! String descriptor

LOCAL
    entry_size,                             ! Size of each index entry
    test,                                   ! -1 (LSS), 0 (EQL), 1 (GTR)
    min,                                    ! Lower search limit
    max,                                    ! Upper search limit
    i;                                      ! Current entry being searched

BUILTIN
    NULLPARAMETER;                  ! True if argument unspecified

MACRO
    entry (i,b,p,s,e) =
        index_block [index$c_entries+(i-1)*.entry_size+b,p,s,e]%;

entry_size = idx$c_length + .index_desc [idd$w_keylen];
min = 1;                                    ! Set min and max limits
max = .index_block [index$w_used]/.entry_size;
```

```
2
2 IF .max EQL 0                          ! If null index block,
2 THEN
3     BEGIN
3     i = 1;                             ! Add at 1st slot
3     test = -1;                         ! No adjustment, key not found
3     END
2 ELSE
2 DO
3     BEGIN
3     i = (.min+.max) / 2;               ! Calculate middle entry
3     IF .index_desc [idd$v_ascii]       ! If ASCII keys,
3     THEN
4         BEGIN
4         IF .index_desc [idd$v_upcasntry]
4         THEN
5             BEGIN
5             LOCAL
5                 entrynambuf : BBLOCK [lbr$c_maxkeylen];
5
5             moveto_upper_case ( .entry [.i,idx$b_keylen],
5                         entry [.i,idx$t_keyname], entrynambuf);
5             test = CH$COMPARE(.key_desc [dsc$w_length], ! Compare ASCII keys
5                 .key_desc [dsc$a_pointer],
5                 .entry [.i,idx$b_keylen],
5                 entrynambuf, 0);
5             END
4         ELSE
4             test = CH$COMPARE(.key_desc [dsc$w_length], ! Compare ASCII keys
4                 .key_desc [dsc$a_pointer],
4                 .entry [.i,idx$b_keylen],
4                 entry [.i,idx$t_keyname],0);
4         END
3     ELSE
3         test = ..key_desc - .entry [.i, idx$l_keyid];
3     IF .test GTR 0
3     THEN
3         min = .i+1                     ! Set to upper half
3     ELSE
3         max = .i-1;                    ! Set to lower half
3     END
3
2     UNTIL (.test EQL 0) OR (.min GTR .max);
2
2 IF .test GTR 0                         ! If greater than last key
2 THEN
2     i = .i+1;                          ! then point after last key
2
2 IF NOT NULLPARAMETER(5)                ! If add position specified,
2 THEN
2     .addpos = (.i-1) * .entry_size;    ! Return offset where to add key
2 !
2 !       If the add position points past the end of the block,
2 !       then adjust the closest entry to point to the last entry
2 !       in the block so that add_key has a block to insert the
2 !       key into.  Note that if the block is empty, return -1.
2 !
```

```
; 1627          2433  2 .genpos = (.i-1) * .entry_size;          ! Return offset to closest entry
; 1628          2434  2 IF ..genpos GEQU .index_block [index$w_used] ! If over block,
; 1629          2435  2 THEN
; 1630          2436  2     .genpos = ..genpos - .entry_size;    ! Set to last entry in block
; 1631          2437  2
; 1632          2438  2 RETURN .test EQL 0;                      ! True if key found
; 1633          2439  2
; 1634          2440  1 END;



                                                       0FFC 00000 KEY_SEARCH:
                                                                          .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11         ; 2320
                                       5E      FF7C  CE  9E 00002         MOVAB   -132(SP), SP                                 ;
                                       5B        04  AC  D0 00007         MOVL    INDEX_DESC, R11                              ; 2373
                                       7E        02  AB  3C 0000B         MOVZWL  2(R11), ENTRY_SIZE                           ;
                                       6E            06  C0 0000F         ADDL2   #6, ENTRY_SIZE                               ;
                                       54            01  D0 00012         MOVL    #1, MIN                                      ; 2374
                                       59        08  BC  3C 00015         MOVZWL  @INDEX_BLOCK, MAX                            ; 2375
                                       59            6E  C6 00019         DIVL2   ENTRY_SIZE, MAX                              ;
                                                     09  12 0001C         BNEQ    1$                                           ; 2377
                                       55            01  D0 0001E         MOVL    #1, I                                        ; 2380
                                       5A            01  CE 00021         MNEGL   #1, TEST                                     ; 2381
                                                   0088  31 00024         BRW     9$                                           ; 2377
                         50            54            59  C1 00027 1$:     ADDL3   MAX, MIN, R0                                 ; 2386
                         55            50            02  C7 0002B         DIVL3   #2, R0, I                                    ;
                                  04   AE        FF  A5  9E 0002F         MOVAB   -1(R5), 4(SP)                                ; 2397
                         50       04   AE            6E  C5 00034         MULL3   ENTRY_SIZE, 4(SP), R0                        ;
                         56            50        08  AC  C1 00039         ADDL3   INDEX_BLOCK, R0, R6                          ; 2396
                                       50            6B  E9 0003E         BLBC    (R11), 5$                                    ; 2387
                         57            50        08  AC  C1 00041         ADDL3   INDEX_BLOCK, R0, R7                          ; 2397
                                       53        0C  AC  D0 00046         MOVL    KEY_DESC, R3                                 ; 2399
                         29            6B            05  E1 0004A         BBC     #5, (R11), 3$                                ; 2390
                                       52        08  AE  9E 0004E         MOVAB   ENTRYNAMBUF, R2                              ; 2397
                                       51        13  A7  9E 00052         MOVAB   19(R7), R1                                   ;
                                       50        12  A6  9A 00056         MOVZBL  18(R6), R0                                   ;
                                                  0000G  30 0005A         BSBW    MOVETO_UPPER_CASE                            ;
                                       50        12  A6  9A 0005D         MOVZBL  18(R6), R0                                   ; 2400
                                       56            01  D0 00061         MOVL    #1, R6                                       ; 2398
           50            00       04   B3        0C  BC  2D 00064         CMPC5   @KEY_DESC, @4(R3), #0, R0, ENTRYNAMBUF       ;
                                                 08  AE     0006B                                                              ;
                                                     03  1A 0006D         BGTRU   2$                                           ;
                                       56            01  D9 0006F         SBWC    #1, R6                                       ;
                                       5A            56  D0 00072 2$:     MOVL    R6, TEST                                     ;
                                                     20  11 00075         BRB     6$                                           ; 2390
                                       50        12  A6  9A 00077 3$:     MOVZBL  18(R6), R0                                   ; 2406
                                       58            01  D0 0007B         MOVL    #1, R8                                       ; 2407
           50            00       04   B3        0C  BC  2D 0007E         CMPC5   @KEY_DESC, @4(R3), #0, R0, 19(R7)            ;
                                                 13  A7     00085                                                              ;
                                                     03  1A 00087         BGTRU   4$                                           ;
                                       58            01  D9 00089         SBWC    #1, R8                                       ;
                                       5A            58  D0 0008C 4$:     MOVL    R8, TEST                                     ;
                                                     06  11 0008F         BRB     6$                                           ; 2387
                         5A       0C   BC        12  A6  C3 00091 5$:     SUBL3   18(R6), @KEY_DESC, TEST                      ; 2410
                                                     06  15 00097 6$:     BLEQ    7$                                           ; 2411
```

```
                             54    01  A5  9E 00099        MOVAB   1(R5), MIN                                 ; 2413
                                       04  11 0009D        BRB     8$                                         ;
                             59    04  AE  D0 0009F 7$:    MOVL    4(SP), MAX                                 ; 2415
                                       5A  D5 000A3 8$:    TSTL    TEST                                       ; 2418
                                       08  13 000A5        BEQL    9$                                         ;
                             59        54  D1 000A7        CMPL    MIN, MAX                                   ;
                                       03  14 000AA        BGTR    9$                                         ;
                                     FF78  31 000AC        BRW     1$                                         ;
                                       5A  D5 000AF 9$:    TSTL    TEST                                       ; 2420
                                       02  15 000B1        BLEQ    10$                                        ;
                                       55  D6 000B3        INCL    I                                          ; 2422
                             05        6C  91 000B5 10$:   CMPB    (AP), #5                                   ; 2424
                                       0E  1F 000B8        BLSSU   11$                                        ;
                                   14  AC  D5 000BA        TSTL    20(AP)                                     ;
                                       09  13 000BD        BEQL    11$                                        ;
                             50    FF  A5  9E 000BF        MOVAB   -1(R5), R0                                 ; 2426
                 14  BC          50    6E  C5 000C3        MULL3   ENTRY_SIZE, R0, @ADDPOS                    ;
                                       55  D7 000C8 11$:   DECL    R5                                         ; 2433
                 10  BC          55    6E  C5 000CA        MULL3   ENTRY_SIZE, R5, @GENPOS                    ;
     10  BC      08  BC          10    00  ED 000CF        CMPZV   #0, #16, @INDEX_BLOCK, @GENPOS             ; 2434
                                       04  1A 000D6        BGTRU   12$                                        ;
                          10  BC       6E  C2 000D8        SUBL2   ENTRY_SIZE, @GENPOS                        ; 2436
                                       50  D4 000DC 12$:   CLRL    R0                                         ; 2438
                                       5A  D5 000DE        TSTL    TEST                                       ;
                                       02  12 000E0        BNEQ    13$                                        ;
                                       50  D6 000E2        INCL    R0                                         ;
                                           04 000E4 13$:   RET                                                ; 2440

; Routine Size:  229 bytes,    Routine Base:  $CODE$ + 0AEA
```

```
  1 %SBTTL  'key_search2';
  1 ROUTINE key_search2 (index_desc, index_block, key_desc, genpos, addpos) =
  1
  1 !---
  1 !
  1 !        Key_search2 is a modified key_search to handle indices with
  1 !        variable length keywords.
  1 !        This routine searches a specified index block using a sequential
  1 !        search and returns the position (offset) within the block
  1 !        where the key should be added (if not found) or its exact
  1 !        position (if found).
  1 !
  1 !        It is also used to run down the index tree to find a given
  1 !        key by searching each index block and using the key found
  1 !        generically using this routine to get to the next index block
  1 !        to be searched (the child).
  1 !
  1 ! Inputs:
  1 !
  1 !        index_desc = Primary index descriptor
  1 !        index_block = Address of the index block
  1 !        key_desc = String descriptor of the key
  1 !        genpos = Longword to receieve offset to the entry which is
  1 !                        most generically close to the key.
  1 !        addpos (optional) = Longword to receieve offset to position
  1 !                        where the key should be added in the block.
  1 !
  1 ! Outputs:
  1 !
  1 !        genpos = Offset to generically closest entry.
  1 !        addpos (if specified) = Offset to position to add key.
  1 !
  1 !        Routine value = true if key found, else false.
  1 !---
  1
  2 BEGIN
  2
  2 MAP
  2     index_desc: REF BBLOCK,                 ! Index descriptor
  2     index_block:        REF BBLOCK,         ! Address of index block
  2     key_desc:           REF BBLOCK;         ! String descriptor
  2
  2 LOCAL
  2     entry_size,                             ! Size of each index entry
  2     test,                                   ! -1 (LSS), 0 (EQL), 1 (GTR)
  2     max,                                    ! offset to end of used index
  2     last_entry,                             ! offset to last entry examined
  2     cur_entry;                              ! offset to current entry examined
  2
  2 BUILTIN
  2     NULLPARAMETER;                  ! True if argument unspecified
  2
  2 MACRO
M 2     entry (i,b,p,s,e) =
  2         index_block [index$c_entries+i+b,p,s,e]%;
  2
  2 IF NOT .index_desc [idd$v_ascii]        ! If not ASCII keys,
2 THEN
2     RETURN lbr$_intrnlerr;                    ! key_search2 only for ASCII keys
2
2 max = .index_block [index$w_used];
2 test = 1;                                     ! Pre set to key not found
2 last_entry = 0;                               ! pre_set to first entry
2 cur_entry = 0;                                ! pre_set to first entry
2
2 IF .max EQL 0                                 ! If null index block,
2 THEN
3     BEGIN
3     test = -1;
3     END
2 ELSE
3     BEGIN
3     WHILE (.test GTR 0) AND (.cur_entry LSS .max) DO
4         BEGIN
4         IF .index_desc [idd$v_upcasntry]
4         THEN
5             BEGIN
5             LOCAL
5                 entrynambuf : BBLOCK [lbr$c_maxkeylen];
5
5             moveto_upper_case (.entry [.cur_entry,idx$b_keylen],
5                          entry [.cur_entry,idx$t_keyname], entrynambuf);
5
5             test = CH$COMPARE(.key_desc [dsc$w_length], ! Compare ASCII keys
5                 .key_desc [dsc$a_pointer],
5                 .entry [.cur_entry,idx$b_keylen],
5                 entrynambuf, 0)
5             END
4         ELSE
4             test = CH$COMPARE(.key_desc [dsc$w_length], ! Compare ASCII keys
4                 .key_desc [dsc$a_pointer],
4                 .entry [.cur_entry,idx$b_keylen],
4                 entry [.cur_entry,idx$t_keyname],0);
5         IF (.test GTR  0)
4         THEN
5             BEGIN
5             last_entry = .cur_entry;
5             cur_entry = .cur_entry + idx$c_rfaplsbyt + .entry[.cur_entry,idx$b_keylen];
4             END;
3         END;            ! While
2     END;
2
2 IF NOT NULLPARAMETER(5)                       ! If add position specified,
2 THEN
2     .addpos = .cur_entry;       ! Return offset where to add key
2 !
2 !       If the add position points past the end of the block,
2 !       then adjust the closest entry to point to the last entry
2 !       in the block so that add_key has a block to insert the
2 !       key into.  Note that if the block is empty, return -1.
2 !
2 .genpos = .cur_entry;           ! Return offset to closest entry
2 IF ..genpos GEQU .index_block [index$w_used] ! If over block,
2 THEN
```

```
; 1750          2555  2       .genpos = .last_entry;       ! Set to last entry in block
; 1751          2556  2
; 1752          2557  2  !
; 1753          2558  2  ! Must propagate actual length of actual index entry string
; 1754          2559  2  !       back to caller
; 1755          2560  2  !
; 1756          2561  2  IF .test EQL 0
; 1757          2562  2  THEN
; 1758          2563  3      BEGIN
; 1759          2564  3      key_desc[dsc$w_length] = .entry[.cur_entry,idx$b_keylen];
; 1760          2565  3      RETURN true;
; 1761          2566  3      END
; 1762          2567  2  ELSE
; 1763          2568  2      RETURN false;
; 1764          2569  2
; 1765          2570  1  END;



                                                  OFFC 00000 KEY_SEARCH2:
                                                                    .WORD    Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11           ; 2442
                                 5E        80   AE   9E 00002             MOVAB    -128(SP), SP                                   ;
                                 08        04   BC   E8 00006             BLBS     @INDEX_DESC, 1$                                ; 2497
                                 50 00000000G   8F   D0 0000A             MOVL     #LBR$_INTRNLERR, R0                            ; 2499
                                                     04 00011             RET                                                     ;
                                 5A        08   BC   3C 00012 1$:         MOVZWL   @INDEX_BLOCK, MAX                              ; 2501
                                 59             01   D0 00016             MOVL     #1, TEST                                       ; 2502
                                                5B   D4 00019             CLRL     LAST_ENTRY                                     ; 2503
                                                57   D4 0001B             CLRL     CUR_ENTRY                                      ; 2504
                                                5A   D5 0001D             TSTL     MAX                                            ; 2506
                                                05   12 0001F             BNEQ     2$                                             ;
                                 59             01   CE 00021             MNEGL    #1, TEST                                       ; 2509
                                                66   11 00024             BRB      8$                                             ; 2506
                                 56        0C   AC   D0 00026 2$:         MOVL     KEY_DESC, R6                                   ; 2525
                                                59   D5 0002A 3$:         TSTL     TEST                                           ; 2513
                                                5E   15 0002C             BLEQ     8$                                             ;
                                 5A             57   D1 0002E             CMPL     CUR_ENTRY, MAX                                 ;
                                                59   18 00031             BGEQ     8$                                             ;
                   54            57        08   AC   C1 00033             ADDL3    INDEX_BLOCK, CUR_ENTRY, R4                     ; 2522
                   53            57        08   AC   C1 00038             ADDL3    INDEX_BLOCK, CUR_ENTRY, R3                     ; 2521
                   26     04     BC             05   E1 0003D             BBC      #5, @INDEX_DESC, 5$                            ; 2515
                                 52             6E   9E 00042             MOVAB    ENTRYNAMBUF, R2                                ; 2522
                                 51        13   A4   9E 00045             MOVAB    19(R4), R1                                     ;
                                 55        12   A3   9A 00049             MOVZBL   18(R3), R5                                     ; 2521
                                 50             55   D0 0004D             MOVL     R5, R0                                         ; 2522
                                             0000G   30 00050             BSBW     MOVETO_UPPER_CASE                              ;
                                 54             01   D0 00053             MOVL     #1, R4                                         ; 2524
         55        00     04     B6        0C   BC   2D 00056             CMPC5    @KEY_DESC, @4(R6), #0, R5, ENTRYNAMBUF         ;
                                                6E      0005D                                                                     ;
                                                03   1A 0005E             BGTRU    4$                                             ;
                                 54             01   D9 00060             SBWC     #1, R4                                         ;
                                 59             54   D0 00063 4$:         MOVL     R4, TEST                                       ;
                                                18   11 00066             BRB      7$                                             ;
                                 55        12   A3   9A 00068 5$:         MOVZBL   18(R3), R5                                     ; 2532
                                 58             01   D0 0006C             MOVL     #1, R8                                         ; 2533
```

```
          55          00      04   B6      0C   BC  2D 0006F          CMPC5   @KEY_DESC, @4(R6), #0, R5, 19(R4)              ;
                                           13   A4     00076                                                                 ;
                                                03  1A 00078          BGTRU   6$                                             ;
                                   58           01  D9 0007A          SBWC    #1, R8                                         ;
                                   59           58  D0 0007D 6$:      MOVL    R8, TEST                                       ;
                                                A8  15 00080 7$:      BLEQ    3$                                             ; 2534
                                   5B           57  D0 00082          MOVL    CUR_ENTRY, LAST_ENTRY                          ; 2537
                                   57      07 A547  9E 00085          MOVAB   7(R5)[CUR_ENTRY], CUR_ENTRY                    ; 2538
                                                9E  11 0008A          BRB     3$                                             ; 2513
                                   05           6C  91 0008C 8$:      CMPB    (AP), #5                                       ; 2543
                                                09  1F 0008F          BLSSU   9$                                             ;
                                           14   AC  D5 00091          TSTL    20(AP)                                         ;
                                                04  13 00094          BEQL    9$                                             ;
                              14   BC           57  D0 00096          MOVL    CUR_ENTRY, @ADDPOS                             ; 2545
                              10   BC           57  D0 0009A 9$:      MOVL    CUR_ENTRY, @GENPOS                             ; 2552
      10   BC     08   BC          10           00  ED 0009E          CMPZV   #0, #16, @INDEX_BLOCK, @GENPOS                 ; 2553
                                                04  1A 000A5          BGTRU   10$                                            ;
                              10   BC           5B  D0 000A7          MOVL    LAST_ENTRY, @GENPOS                            ; 2555
                                                59  D5 000AB 10$:     TSTL    TEST                                           ; 2561
                                                0E  12 000AD          BNEQ    11$                                            ;
                  50               57      08   AC  C1 000AF          ADDL3   INDEX_BLOCK, CUR_ENTRY, R0                     ; 2564
                              0C   BC      12   A0  9B 000B4          MOVZBW  18(R0), @KEY_DESC                              ;
                                   50           01  D0 000B9          MOVL    #1, R0                                         ; 2568
                                                    04 000BC          RET                                                    ;
                                                50  D4 000BD 11$:     CLRL    R0                                             ;
                                                    04 000BF          RET                                                    ; 2570

; Routine Size:  192 bytes,    Routine Base:  $CODE$ + 0BCF
```

```
%SBTTL  'find_index';
GLOBAL ROUTINE find_index (vbn, address) : JSB_2 =

!---
!
!       This routine locates a specific block in the library
!       file and returns the address of the block in memory
!       If the block is not currently cached in memory, it
!       will be automatically read from disk and added to the
!       cache.
!
! Inputs:
!
!       vbn = requested block number in file
!       address = Longword to receive address of block
!
! Outputs:
!
!       address = Address of block in memory
!---

BEGIN

BIND
    header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;

LOCAL
    status,
    cache_entry: REF BBLOCK;            ! Current cache entry address

status = lookup_cache(.vbn, cache_entry); ! Lookup block in cache

IF .status                              ! If found,
THEN
    BEGIN
    .address = .cache_entry [cache$l_address];  ! Return address
    RETURN true;
    END;

!
! Attempt to read in multiple blocks if vbn is in the pre-allocated index
!
IF .vbn LEQU .header[lhd$l_hiprusd]
THEN BEGIN
    perform (read_n_block (.vbn, MIN (.lbr$gl_maxidxrd, !Read in some index blocks
                    (.header [lhd$l_hiprusd] - .vbn + 1))));
    perform(find_index(.vbn, .address));        !Recurse to lookup in cache
    END
ELSE BEGIN
    perform(read_block(.vbn,.address)); ! Read from disk

    perform (add_cache (.vbn, cache_entry));! Add cache list entry
    cache_entry [cache$l_address] = ..address;

    END;

RETURN true;

```

```
; 1824          2628  1 END;




                                          1C  BB 00000 FIND_INDEX::
                                                                    PUSHR   #^M<R2,R3,R4>                            ; 2572
                          5E              04  C2 00002              SUBL2   #4, SP                                   ;
                          53              50  7D 00005              MOVQ    R0, R3                                   ;
                          50       0000G  CF  D0 00008              MOVL    LBR$GL_CONTROL, R0                       ; 2594
                          52          0A  A0  D0 0000D              MOVL    10(R0), R2                               ;
                          51              6E  9E 00011              MOVAB   CACHE_ENTRY, R1                          ; 2600
                          50              53  D0 00014              MOVL    VBN, R0                                  ;
                                       0000G  30 00017              BSBW    LOOKUP_CACHE                             ;
                          09              50  E9 0001A              BLBC    STATUS, 1$                               ; 2602
                          50              6E  D0 0001D              MOVL    CACHE_ENTRY, R0                          ; 2605
                          64          08  A0  D0 00020              MOVL    8(R0), (ADDRESS)                         ;
                                          4B  11 00024              BRB     4$                                       ; 2606
                     62   A2              53  D1 00026 1$:          CMPL    VBN, 98(R2)                              ; 2612
                                          29  1A 0002A              BGTRU   3$                                       ;
           52        62   A2              53  C3 0002C              SUBL3   VBN, 98(R2), R2                          ; 2615
                          50          01  A2  9E 00031              MOVAB   1(R2), R0                                ;
                          51       0000G  CF  D0 00035              MOVL    LBR$GL_MAXIDXRD, R1                      ;
                          50              51  D1 0003A              CMPL    R1, R0                                   ;
                                          03  15 0003D              BLEQ    2$                                       ;
                          51              50  D0 0003F              MOVL    R0, R1                                   ;
                          50              53  D0 00042 2$:          MOVL    VBN, R0                                  ;
                                       0000G  30 00045              BSBW    READ_N_BLOCK                             ;
                          29              50  E9 00048              BLBC    STATUS, 5$                               ;
                          50              53  7D 0004B              MOVQ    VBN, R0                                  ; 2616
                                          B0  10 0004E              BSBB    FIND_INDEX                               ;
                          1E              50  E8 00050              BLBS    STATUS, 4$                               ;
                                          1F  11 00053              BRB     5$                                       ;
                          50              53  7D 00055 3$:          MOVQ    VBN, R0                                  ; 2619
                                       0000G  30 00058              BSBW    READ_BLOCK                               ;
                          16              50  E9 0005B              BLBC    STATUS, 5$                               ;
                          51              6E  9E 0005E              MOVAB   CACHE_ENTRY, R1                          ; 2621
                          50              53  D0 00061              MOVL    VBN, R0                                  ;
                                       0000G  30 00064              BSBW    ADD_CACHE                                ;
                          0A              50  E9 00067              BLBC    STATUS, 5$                               ;
                          50              6E  D0 0006A              MOVL    CACHE_ENTRY, R0                          ; 2622
                     08   A0              64  D0 0006D              MOVL    (ADDRESS), 8(R0)                         ;
                          50              01  D0 00071 4$:          MOVL    #1, R0                                   ; 2626
                          5E              04  C0 00074 5$:          ADDL2   #4, SP                                   ; 2628
                                          1C  BA 00077              POPR    #^M<R2,R3,R4>                            ;
                                              05 00079              RSB                                              ;

; Routine Size:  122 bytes,    Routine Base:  $CODE$ + 0C8F
```

```
1 %SBTTL  'create_index';
1 ROUTINE create_index (vbn, address) =
1 !---
1 !
1 !       This routine allocates a new index block in the file,
1 !       initializes it, and returns the rfa and address.
1 !
1 ! Inputs:
1 !
1 !       None
1 !
1 ! Outputs:
1 !
1 !       vbn = VBN of newly allocated index block
1 !       address = Address of index block in memory
1 !---
1
2 BEGIN
2
2 BIND
2     context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK,
2     header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
2
2 LOCAL
2     cache_entry: REF BBLOCK;    ! New cache entry address
2
2 !
2 ! Allocate block from index cache if possible
2 !
2 IF .header[lhd$l_freeidx] NEQ 0
3 THEN BEGIN
3     LOCAL
3         buffer : REF VECTOR[,LONG];
3
3     perform(find_block(.header[lhd$l_freeidx], .address, cache_entry));
3     buffer = ..address;
3     .vbn = .header[lhd$l_freeidx];
3     header[lhd$l_freeidx] = .buffer[0];
3     CH$FILL(0, idx$c_length, .buffer);
3     header[lhd$l_freidxblk] = .header[lhd$l_freidxblk] - 1;
3     IF ..vbn GTRU .header[lhd$l_hiprusd]
3         THEN header[lhd$l_hiprusd] = ..vbn;
3     END
3 ELSE BEGIN
3     perform(alloc_block(.vbn, .address));       ! Allocate a disk block
3 !
3 !       Add the allocated block to the index cache
3 !
3     perform (add_cache (..vbn, cache_entry));! Add block to cache list
3     cache_entry [cache$l_address] = ..address;
3 !
3 !       Initialize the index block
3 !
4     BEGIN
4         BIND
4             index_block = ..address: BBLOCK;    ! Address index block
4
```

```
                                                                F  4
LBR_INDEX                                                       16-Sep-1984 01:56:12    VAX-11 Bliss-32 V4.0-742                  Page  66
V04-000           create_index                                  14-Sep-1984 12:37:41    DISK$VMSMASTER:[LBR.SRC]INDEX.B32;1          (21)

; 1883          2686  4             index_block [index$w_used] = 0;            ! No space used initially
; 1884          2687  3         END;
; 1885          2688  2     END;
; 1886          2689  2     mark_dirty(..vbn);                          ! Mark index block modified
; 1887          2690  2
; 1888          2691  2     header[lhd$l_idxblks] = .header[lhd$l_idxblks] + 1;     ! Count another index block
; 1889          2692  2
; 1890          2693  2     context [ctx$v_hdrdirty] = true;            ! Mark header dirty
; 1891          2694  2
; 1892          2695  2     RETURN true;
; 1893          2696  2
; 1894          2697  1     END;



                                                  OFFC 00000 CREATE_INDEX:
                                                                   .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 2630
                               5E          04  C2 00002            SUBL2   #4, SP                                        ;
                               50       0000G  CF  D0 00005        MOVL    LBR$GL_CONTROL, R0                            ; 2649
                               58          0E  A0  D0 0000A        MOVL    14(R0), R8                                    ;
                               56          0A  A0  D0 0000E        MOVL    10(R0), R6                                    ; 2650
                               57          04  AC  D0 00012        MOVL    VBN, R7                                       ; 2665
                               53          5A  A6  D0 00016        MOVL    90(R6), R3                                    ; 2658
                                               33  13 0001A        BEQL    1$                                            ;
                               52              6E  9E 0001C        MOVAB   CACHE_ENTRY, R2                               ; 2663
                               51          08  AC  D0 0001F        MOVL    ADDRESS, R1                                   ;
                               50              53  D0 00023        MOVL    R3, R0                                        ;
                                            0000G  30 00026        BSBW    FIND_BLOCK                                    ;
                               5D              50  E9 00029        BLBC    STATUS, 3$                                    ;
                               50          08  BC  D0 0002C        MOVL    @ADDRESS, BUFFER                              ; 2664
                               67              53  D0 00030        MOVL    R3, (R7)                                      ; 2665
                          5A   A6              60  D0 00033        MOVL    (BUFFER), 90(R6)                              ; 2666
         06         00    6E                   00  2C 00037        MOVC5   #0, (SP), #0, #6, (BUFFER)                    ; 2667
                                               60     0003C                                                              ;
                                      56   A6  D7 0003D            DECL    86(R6)                                        ; 2668
                               52              67  D0 00040        MOVL    (R7), R2                                      ; 2669
                          62   A6              52  D1 00043        CMPL    R2, 98(R6)                                    ;
                                               30  1B 00047        BLEQU   2$                                            ;
                          62   A6              52  D0 00049        MOVL    R2, 98(R6)                                    ; 2670
                                               2A  11 0004D        BRB     2$                                            ; 2658
                               51          08  AC  D0 0004F 1$:    MOVL    ADDRESS, R1                                   ; 2673
                               50              57  D0 00053        MOVL    R7, R0                                        ;
                                            0000G  30 00056        BSBW    ALLOC_BLOCK                                   ;
                               2D              50  E9 00059        BLBC    STATUS, 3$                                    ;
                               51              6E  9E 0005C        MOVAB   CACHE_ENTRY, R1                               ; 2677
                               52              67  D0 0005F        MOVL    (R7), R2                                      ;
                               50              52  D0 00062        MOVL    R2, R0                                        ;
                                            0000G  30 00065        BSBW    ADD_CACHE                                     ;
                               1E              50  E9 00068        BLBC    STATUS, 3$                                    ;
                               50              6E  D0 0006B        MOVL    CACHE_ENTRY, R0                               ; 2678
                          08   A0          08  BC  D0 0006E        MOVL    @ADDRESS, 8(R0)                               ;
                               50          08  BC  D0 00073        MOVL    @ADDRESS, R0                                  ; 2684
                                               60  B4 00077        CLRW    (R0)                                          ; 2686
                               50              52  D0 00079 2$:    MOVL    R2, R0                                        ; 2689
                                            0000V  30 0007C        BSBW    MARK_DIRTY                                    ;
```

```
                                          66    A6  D6 0007F            INCL    102(R6)                                   ; 2691
                         04    A8               08  88 00082            BISB2   #8, 4(R8)                                 ; 2693
                               50               01  D0 00086            MOVL    #1, R0                                    ; 2695
                                                    04 00089 3$:        RET                                               ; 2697

; Routine Size:  138 bytes,    Routine Base:  $CODE$ + 0D09
; 1896          2698   1 %SBTTL  'delete_index';
; 1897          2699   1 ROUTINE delete_index (vbn) =
; 1898          2700   1
; 1899          2701   1 !---
; 1900          2702   1 !
; 1901          2703   1 !         Deallocate the memory used by an index block and
; 1902          2704   1 !         remove the cache entry.
; 1903          2705   1 !
; 1904          2706   1 ! Inputs:
; 1905          2707   1 !
; 1906          2708   1 !         vbn = VBN of index block to delete.
; 1907          2709   1 !
; 1908          2710   1 ! Outputs:
; 1909          2711   1 !
; 1910          2712   1 !         None
; 1911          2713   1 !---
; 1912          2714   1
; 1913          2715   2 BEGIN
; 1914          2716   2
; 1915          2717   2 BIND
; 1916          2718   2     context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK,
; 1917          2719   2     header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
; 1918          2720   2
; 1919          2721   2 LOCAL
; 1920          2722   2     blockaddr : REF VECTOR[,LONG],
; 1921          2723   2     status,
; 1922          2724   2     cache_entry : REF BBLOCK;
; 1923          2725   2
; 1924          2726   2 perform(find_block(.vbn, blockaddr, cache_entry));       !Get block in memory
; 1925          2727   2 IF .vbn LEQU .header[lhd$l_hipreal]
; 1926          2728   3 THEN BEGIN
; 1927          2729   3     blockaddr[0] = .header[lhd$l_freeidx];
; 1928          2730   3     header[lhd$l_freeidx] = .vbn;
; 1929          2731   3     header[lhd$l_freidxblk] = .header[lhd$l_freidxblk] + 1;
; 1930          2732   3     cache_entry[cache$v_dirty] = true;
; 1931          2733   3     END
; 1932          2734   2 ELSE perform (dealloc_block (.vbn));            ! Just deallocate block
; 1933          2735   2
; 1934          2736   2 header[lhd$l_idxblks] = .header[lhd$l_idxblks] - 1;
; 1935          2737   2
; 1936          2738   2 context [ctx$v_hdrdirty] = true;                ! Mark header dirty
; 1937          2739   2 RETURN true;
; 1938          2740   2
; 1939          2741   1 END;



                                               0FFC 00000 DELETE_INDEX:
                                                                .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 2699
                     5E          08   C2 00002                  SUBL2   #8, SP                                        ;
                     50       00000G  CF   D0 00005             MOVL    LBR$GL_CONTROL, R0                            ; 2718
                     53          0A   A0   7D 0000A             MOVQ    10(R0), R3                                    ; 2719
                     52               6E   9E 0000E             MOVAB   CACHE_ENTRY, R2                               ; 2726
                     51          04   AE   9E 00011             MOVAB   BLOCKADDR, R1                                 ;
                     50          04   AC   D0 00015             MOVL    VBN, R0                                       ;
```

```
                                                                         I 4
LBR_INDEX                                                        16-Sep-1984 01:56:12    VAX-11 Bliss-32 V4.0-742                      Page  69
V04-000          delete_index                                    14-Sep-1984 12:37:41    DISK$VMSMASTER:[LBR.SRC]INDEX.B32;1            (22)

                                                    0000G  30 00019           BSBW    FIND_BLOCK                                  ;
                                 31                    50  E9 0001C           BLBC    STATUS, 3$                                  ;
                             5E  A3          04        AC  D1 0001F           CMPL    VBN, 94(R3)                                 ; 2727
                                                       16  1A 00024           BGTRU   1$                                          ;
                             04  BE          5A        A3  D0 00026           MOVL    90(R3), @BLOCKADDR                          ; 2729
                             5A  A3          04        AC  D0 0002B           MOVL    VBN, 90(R3)                                 ; 2730
                                             56        A3  D6 00030           INCL    86(R3)                                      ; 2731
                                 50                    6E  D0 00033           MOVL    CACHE_ENTRY, R0                             ; 2732
                             0C  A0                    01  88 00036           BISB2   #1, 12(R0)                                  ;
                                                       0A  11 0003A           BRB     2$                                          ; 2727
                                 50          04        AC  D0 0003C 1$:       MOVL    VBN, R0                                     ; 2734
                                                    0000G  30 00040           BSBW    DEALLOC_BLOCK                               ;
                                 0A                    50  E9 00043           BLBC    STATUS, 3$                                  ;
                                             66        A3  D7 00046 2$:       DECL    102(R3)                                     ; 2736
                             04  A4                    08  88 00049           BISB2   #8, 4(R4)                                   ; 2738
                                 50                    01  D0 0004D           MOVL    #1, R0                                      ; 2739
                                                           04 00050 3$:       RET                                                 ; 2741

; Routine Size:  81 bytes,    Routine Base:  $CODE$ + 0D93
```

```
%SBTTL  'add_index';
ROUTINE add_index (index, vbn, index_block) =

!---
!
!       Create a key which points to the specified index block
!       in the parent index block.  The highest key in the
!       current block is used as the key value.
!
! Inputs:
!
!       vbn = VBN of the index block
!       index = Primary index number
!
! Outputs:
!
!       None
!---

BEGIN

MAP
    index_block: REF BBLOCK;            ! Address of index block

LOCAL
    entry_size,                         ! Size of each entry
    last_entry: REF BBLOCK,             ! Last index entry in block
    index_desc: REF BBLOCK,             ! Address of index descriptor
    rfa: BBLOCK [rfa$c_length];         ! RFA to be associated with key

index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
                + (.index-1)*idd$c_length;
!
!       Find the last entry in the index block.
!
entry_size = idx$c_length + .index_desc [idd$w_keylen];
last_entry = .index_block + index$c_entries
        + .index_block [index$w_used] - .entry_size;
!
!       Setup special RFA which points to this index block.
!
rfa [rfa$l_vbn] = .vbn;                 ! Point to this block
rfa [rfa$w_offset] = rfa$c_index;       ! Mark as index pointer
!
!       Add the key to the parent index.
!
IF .index_desc [idd$v_ascii]            ! If ASCII string keys,
THEN
    BEGIN
    LOCAL
        desc: BBLOCK [dsc$c_s_bln];     ! String descriptor

    desc [dsc$w_length] = .last_entry [idx$b_keylen];
    desc [dsc$a_pointer] = last_entry [idx$t_keyname];
    perform( add_key (.index, desc, rfa,
                .index_block [index$l_parent]) );
```

```
; 1998            2799  3            END
; 1999            2800  2     ELSE
; 2000          P 2801  2            perform( add_key (.index,last_entry[idx$l_keyid],rfa,
; 2001            2802  2                          .index_block [index$l_parent]) );
; 2002            2803  2
; 2003            2804  2     RETURN true;
; 2004            2805  2
; 2005            2806  1     END;



                                             0004 00000 ADD_INDEX:
                                                              .WORD    Save R2                                       ; 2743
                        5E            10  C2 00002            SUBL2    #16, SP                                       ;
                        51      0000G CF  D0 00005            MOVL     LBR$GL_CONTROL, R1                            ; 2773
                        50         04 AC  D0 0000A            MOVL     INDEX, R0                                     ; 2774
                        52    0A B140     7E 0000E            MOVAQ    @10(R1)[R0], INDEX_DESC                       ;
                        52       00BC C2  9E 00013            MOVAB    188(R2), INDEX_DESC                           ;
                        51         02 A2  3C 00018            MOVZWL   2(INDEX_DESC), ENTRY_SIZE                     ; 2778
                        51            06  C0 0001C            ADDL2    #6, ENTRY_SIZE                                ;
                        50         0C BC  3C 0001F            MOVZWL   @INDEX_BLOCK, R0                              ; 2780
                        50         0C AC  C0 00023            ADDL2    INDEX_BLOCK, R0                               ;
                        50            51  C2 00027            SUBL2    ENTRY_SIZE, R0                                ;
                        50            0C  C0 0002A            ADDL2    #12, LAST_ENTRY                               ;
                  08    AE         08 AC  D0 0002D            MOVL     VBN, RFA                                      ; 2784
                  0C    AE         01 AE  00032               MNEGW    #1, RFA+4                                     ; 2785
                        51         0C AC  D0 00036            MOVL     INDEX_BLOCK, R1                               ; 2798
                        14            62  E9 0003A            BLBC     (INDEX_DESC), 1$                              ; 2789
                        6E         06 A0  9B 0003D            MOVZBW   6(LAST_ENTRY), DESC                           ; 2795
                  04    AE         07 A0  9E 00041            MOVAB    7(R0), DESC+4                                 ; 2796
                                   02 A1  DD 00046            PUSHL    2(R1)                                         ; 2798
                                   0C AE  9F 00049            PUSHAB   RFA                                           ;
                                   08 AE  9F 0004C            PUSHAB   DESC                                          ;
                                      09  11 0004F            BRB      2$                                            ;
                                   02 A1  DD 00051 1$:        PUSHL    2(R1)                                         ; 2802
                                   0C AE  9F 00054            PUSHAB   RFA                                           ;
                                   06 A0  9F 00057            PUSHAB   6(LAST_ENTRY)                                 ;
                                   04 AC  DD 0005A 2$:        PUSHL    INDEX                                         ;
                F66A    CF            04  FB 0005D            CALLS    #4, ADD_KEY                                   ;
                        03            50  E9 00062            BLBC     STATUS, 3$                                    ;
                        50            01  D0 00065            MOVL     #1, R0                                        ; 2804
                                          04 00068 3$:        RET                                                    ; 2806

; Routine Size:  105 bytes,    Routine Base:  $CODE$ + 0DE4
```

```
1 %SBTTL  'add_index2';
1 ROUTINE add_index2 (index, vbn, index_block) =
1
1 !---
1 !
1 !       Add_index2 is a modified add_index to handle indices
1 !       with variable length keywords.
1 !       Create a key which points to the specified index block
1 !       in the parent index block.  The highest key in the
1 !       current block is used as the key value.
1 !
1 ! Inputs:
1 !
1 !       vbn = VBN of the index block
1 !       index = Primary index number
1 !
1 ! Outputs:
1 !
1 !       None
1 !---
1
2 BEGIN
2
2 MAP
2     index_block: REF BBLOCK;              ! Address of index block
2
2 LOCAL
2     entry_size,                           ! Size of each entry
2     last_entry: REF BBLOCK,               ! Last index entry in block
2     next_entry : REF BBLOCK,              ! search for last index entry in block.
2     index_desc: REF BBLOCK,               ! Address of index descriptor
2     rfa: BBLOCK [rfa$c_length];           ! RFA to be associated with key
2
2
2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
2               + (.index-1)*idd$c_length;
2 !
2 !       Find the last entry in the index block.
2 !
2 last_entry = .index_block + index$c_entries;
2 next_entry = .last_entry;
2 WHILE .next_entry LSS .index_block+index$c_entries+.index_block[index$w_used] DO
3     BEGIN
3     last_entry = .next_entry;
3     next_entry = .next_entry + idx$c_rfaplsbyt + .next_entry[idx$b_keylen];
2     END;
2 !
2 !       Setup special RFA which points to this index block.
2 !
2 rfa [rfa$l_vbn] = .vbn;                   ! Point to this block
2 rfa [rfa$w_offset] = rfa$c_index;        ! Mark as index pointer
2 !
2 !       Add the key to the parent index.
2 !
2 IF .index_desc [idd$v_ascii]             ! If ASCII string keys,
2 THEN
3     BEGIN
```

```
; 2064           2864  3          LOCAL
; 2065           2865  3              desc: BBLOCK [dsc$c_s_bln];      ! String descriptor
; 2066           2866  3
; 2067           2867  3          desc [dsc$w_length] = .last_entry [idx$b_keylen];
; 2068           2868  3          desc [dsc$a_pointer] = last_entry [idx$t_keyname];
; 2069         P 2869  3          perform( add_key (.index, desc, rfa,
; 2070           2870  3                      .index_block [index$l_parent]) );
; 2071           2871  3          END
; 2072           2872  2      ELSE
; 2073           2873  2          RETURN lbr$_intrnlerr;                 ! add_index2 only for ASCII keys
; 2074           2874  2
; 2075           2875  2      RETURN true;
; 2076           2876  2
; 2077           2877  1      END;



                                          001C 00000 ADD_INDEX2:
                                                             .WORD    Save R2,R3,R4                                    ; 2808
                    5E            10   C2 00002              SUBL2    #16, SP                                          ;
                    51     0000G  CF   D0 00005              MOVL     LBR$GL_CONTROL, R1                               ; 2841
                    50        04  AC   D0 0000A              MOVL     INDEX, R0                                        ; 2842
                    54     0A B140  7E 0000E                 MOVAQ    @10(R1)[R0], INDEX_DESC                          ;
                    54      00BC  C4   9E 00013              MOVAB    188(R4), INDEX_DESC                              ;
                    53        0C  AC   D0 00018              MOVL     INDEX_BLOCK, R3                                  ; 2846
                    50        0C  A3   9E 0001C              MOVAB    12(R3), LAST_ENTRY                               ;
                    52            50   D0 00020              MOVL     LAST_ENTRY, NEXT_ENTRY                           ; 2847
                    51            63   3C 00023 1$:          MOVZWL   (R3), R1                                         ; 2848
                    51     0C A341  9E 00026                 MOVAB    12(R3)[R1], R1                                   ;
                    51            52   D1 0002B              CMPL     NEXT_ENTRY, R1                                   ;
                                  0E   18 0002E              BGEQ     2$                                               ;
                    50            52   D0 00030              MOVL     NEXT_ENTRY, LAST_ENTRY                           ; 2850
                    51        06  A2   9A 00033              MOVZBL   6(NEXT_ENTRY), R1                                ; 2851
                    52     07 A142  9E 00037                 MOVAB    7(R1)[NEXT_ENTRY], NEXT_ENTRY                    ;
                                  E5   11 0003C              BRB      1$                                               ; 2848
               08   AE        08  AC   D0 0003E 2$:          MOVL     VBN, RFA                                         ; 2856
               0C   AE            01   AE 00043              MNEGW    #1, RFA+4                                        ; 2857
                    1E            64   E9 00047              BLBC     (INDEX_DESC), 3$                                 ; 2861
                    6E        06  A0   9B 0004A              MOVZBW   6(LAST_ENTRY), DESC                              ; 2867
               04   AE        07  A0   9E 0004E              MOVAB    7(R0), DESC+4                                    ; 2868
                              02  A3   DD 00053              PUSHL    2(R3)                                            ; 2870
                              0C  AE   9F 00056              PUSHAB   RFA                                              ;
                              08  AE   9F 00059              PUSHAB   DESC                                             ;
                              04  AC   DD 0005C              PUSHL    INDEX                                            ;
             F5FF   CF            04   FB 0005F              CALLS    #4, ADD_KEY                                      ;
                    09            50   E8 00064              BLBS     STATUS, 4$                                       ;
                                       04 00067              RET                                                       ;
                    50 00000000G  8F   D0 00068 3$:          MOVL     #LBR$_INTRNLERR, R0                              ; 2873
                                       04 0006F              RET                                                       ;
                    50            01   D0 00070 4$:          MOVL     #1, R0                                           ; 2875
                                       04 00073              RET                                                       ; 2877

; Routine Size:  116 bytes,    Routine Base:  $CODE$ + 0E4D
```

```
1 %SBTTL  'reset_highest';
1 ROUTINE reset_highest (index_desc, vbn, index_block) =
1
1 !---
1 !
1 !       Reset the index pointers in the parent blocks
1 !       pointing to the specified index block.  Each
1 !       index pointer in a parent block contains the
1 !       highest key in the subindex block in order for
1 !       binary searches to work.  This routine is called
1 !       when the index block has changed in order to
1 !       reset the parents highest keys to the proper value.
1 !
1 ! Inputs:
1 !
1 !       index_desc = Address of primary index descriptor
1 !       vbn = VBN of index block
1 !       index_block = Address of index block
1 !
1 ! Outputs:
1 !
1 !       The highest keys in the parents are reset.
1 !
1 !---
1
2 BEGIN
2
2 MAP
2     index_desc: REF BBLOCK,             ! Address of index descriptor
2     index_block: REF BBLOCK;            ! Address of index block
2
2 LOCAL
2     entry_size,                         ! Size of each entry
2     last_entry: REF BBLOCK,             ! Last index entry in block
2     parent_block: REF BBLOCK,           ! Address of parent block
2     parent_entry: REF BBLOCK;           ! Address of parent entry
2
2
2 IF .index_block [index$l_parent] EQL 0  ! If no parent
2 THEN
2     RETURN true;                        ! then return done
2 !
2 !       Find the last entry in the index block.
2 !
2 entry_size = idx$c_length + .index_desc [idd$w_keylen];
2 last_entry = .index_block + index$c_entries
2         + .index_block [index$w_used] - .entry_size;
2 !
2 !       Find the parent index block.
2 !
2 perform (find_index (.index_block [index$l_parent], parent_block));
2 !
2 !       Locate the pointer to the subindex block.
2 !
2 INCRU entry FROM .parent_block+index$c_entries BY .entry_size
2 DO
3     BEGIN
```

```
; 2136          2935  3        MAP
; 2137          2936  3            entry: REF BBLOCK;                ! Address index entry
; 2138          2937  3
; 2139          2938  3        IF .entry [idx$l_vbn] EQL .vbn       ! If points to subindex,
; 2140          2939  3        THEN
; 2141          2940  4            BEGIN
; 2142          2941  4            parent_entry = .entry;           ! Set address of parent entry
; 2143          2942  4            EXITLOOP;                        ! then exit the scan
; 2144          2943  3            END;
; 2145          2944  2        END;
; 2146          2945  2    !
; 2147          2946  2    !       Update the key in the parent index.
; 2148          2947  2    !
; 2149          2948  2    IF .index_desc [idd$v_ascii]             ! If ASCII string keys,
; 2150          2949  2    THEN
; 2151          2950  3        BEGIN
; 2152          2951  3        parent_entry [idx$b_keylen] = .last_entry [idx$b_keylen];
; 2153          2952  3        CH$MOVE(.last_entry [idx$b_keylen], ! Copy ASCII key
; 2154          2953  3                last_entry [idx$t_keyname],
; 2155          2954  3                parent_entry [idx$t_keyname]);
; 2156          2955  3        END
; 2157          2956  2    ELSE
; 2158          2957  2        parent_entry [idx$l_keyid] = .last_entry [idx$l_keyid];
; 2159          2958  2    !
; 2160          2959  2    !       Mark the parent index block modified.
; 2161          2960  2    !
; 2162          2961  2    mark_dirty(.index_block [index$l_parent]);
; 2163          2962  2    !
; 2164          2963  2    !       Reset the highest key in the parents parent.
; 2165          2964  2    !
; 2166          2965  2    reset_highest(.index_desc,.index_block [index$l_parent],.parent_block);
; 2167          2966  2
; 2168          2967  2    RETURN true;
; 2169          2968  2
; 2170          2969  1    END;



                                           OFFC 00000 RESET_HIGHEST:
                                                              .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11         ; 2879
                        5E          04  C2 00002              SUBL2   #4, SP                                       ;
                        51      0C  AC  D0 00005              MOVL    INDEX_BLOCK, R1                              ; 2916
                        57      02  A1  D0 00009              MOVL    2(R1), R7                                    ;
                                    60  13 0000D              BEQL    6$                                           ;
                        56      04  AC  D0 0000F              MOVL    INDEX_DESC, R6                               ; 2922
                        53      02  A6  3C 00013              MOVZWL  2(R6), ENTRY_SIZE                            ;
                        53          06  C0 00017              ADDL2   #6, ENTRY_SIZE                               ;
                        50          61  3C 0001A              MOVZWL  (R1), R0                                     ; 2924
           52           50          51  C1 0001D              ADDL3   R1, R0, R2                                   ;
                        52          53  C2 00021              SUBL2   ENTRY_SIZE, R2                               ;
                        52          0C  C0 00024              ADDL2   #12, LAST_ENTRY                              ;
                        51          6E  9E 00027              MOVAB   PARENT_BLOCK, R1                             ; 2928
                        50          57  D0 0002A              MOVL    R7, R0                                       ;
                                  FD9E  30 0002D              BSBW    FIND_INDEX                                   ;
                        3F          50  E9 00030              BLBC    STATUS, 7$                                   ;
```

```
                   51          6E            0C  C1 00033           ADDL3   #12, PARENT_BLOCK, ENTRY                            ; 2938
                         08    AC            61  D1 00037 1$:       CMPL    (ENTRY), VBN                                         ;
                                             05  12 0003B           BNEQ    2$                                                   ;
                               50            51  D0 0003D           MOVL    ENTRY, PARENT_ENTRY                                  ; 2941
                                             05  11 00040           BRB     3$                                                   ; 2940
                               51            53  C0 00042 2$:       ADDL2   ENTRY_SIZE, ENTRY                                    ; 2932
                                             F0  11 00045           BRB     1$                                                   ;
                               11            66  E9 00047 3$:       BLBC    (R6), 4$                                             ; 2948
                         06    A0      06    A2  90 0004A           MOVB    6(LAST_ENTRY), 6(PARENT_ENTRY)                       ; 2951
                               51      06    A2  9A 0004F           MOVZBL  6(LAST_ENTRY), R1                                    ; 2952
              07    A0   07    A2            51  28 00053           MOVC3   R1, 7(LAST_ENTRY), 7(PARENT_ENTRY)                   ; 2954
                                             05  11 00059           BRB     5$                                                   ; 2948
                         06    A0      06    A2  D0 0005B 4$:       MOVL    6(LAST_ENTRY), 6(PARENT_ENTRY)                       ; 2957
                               50            57  D0 00060 5$:       MOVL    R7, R0                                               ; 2961
                                          0000V  30 00063           BSBW    MARK_DIRTY                                           ;
                                             6E  DD 00066           PUSHL   PARENT_BLOCK                                         ; 2965
                               7E            56  7D 00068           MOVQ    R6, -(SP)                                            ;
                         91    AF            03  FB 0006B           CALLS   #3, RESET_HIGHEST                                    ;
                               50            01  D0 0006F 6$:       MOVL    #1, R0                                               ; 2967
                                                 04 00072 7$:       RET                                                          ; 2969

; Routine Size:  115 bytes,    Routine Base:  $CODE$ + 0EC1
```

```
1 %SBTTL  'reset_highest2';
1 ROUTINE reset_highest2 (index, index_desc, vbn, index_block) =
1
1 !---
1 !
1 !       Reset_highest2 is a modified reset_highest
1 !       to handle variable length keyword indices.
1 !       Reset the index pointers in the parent blocks
1 !       pointing to the specified index block.  Each
1 !       index pointer in a parent block contains the
1 !       highest key in the subindex block in order for
1 !       binary searches to work.  This routine is called
1 !       when the index block has changed in order to
1 !       reset the parents highest keys to the proper value.
1 !
1 ! Inputs:
1 !
1 !       index_desc = Address of primary index descriptor
1 !       vbn = VBN of index block
1 !       index_block = Address of index block
1 !
1 ! Outputs:
1 !
1 !       The highest keys in the parents are reset.
1 !
1 !---
1
2 BEGIN
2
2 MAP
2     index_desc: REF BBLOCK,             ! Address of index descriptor
2     index_block: REF BBLOCK;            ! Address of index block
2
2 LOCAL
2     entry,                              ! index block entry
2     entry_size,                         ! Size of each entry
2     last_entry: REF BBLOCK,             ! Last index entry in block
2     next_entry : REF BBLOCK,            ! search for last index entry in block.
2     parent_block: REF BBLOCK,           ! Address of parent block
2     parent_entry: REF BBLOCK;           ! Address of parent entry
2
2
2 IF .index_block [index$l_parent] EQL 0  ! If no parent
2 THEN
2     RETURN true;                        ! then return done
2 !
2 !       Find the last entry in the index block.
2 !
2 next_entry = .index_block + index$c_entries;
2 WHILE .next_entry LSS .index_block+index$c_entries+.index_block[index$w_used] DO
3     BEGIN
3     last_entry = .next_entry;
3     next_entry = .next_entry + idx$c_rfaplsbyt + .next_entry[idx$b_keylen];
2     END;
2 !
2 !       Find the parent index block.
2 !
```

```
2 perform (find_index (.index_block [index$l_parent], parent_block));
2 !
2 !       Locate the pointer to the subindex block.
2 !
2 entry = .parent_block+index$c_entries;
2 WHILE true DO
3     BEGIN
3     MAP
3         entry: REF BBLOCK;                 ! Address index entry
3
3     IF .entry [idx$l_vbn] EQL .vbn        ! If points to subindex.
3     THEN
4         BEGIN
4         parent_entry = .entry;             ! Set address of parent entry
4         EXITLOOP;                          ! then exit the scan
4         END
3     ELSE
3         entry = .entry + idx$c_rfaplsbyt + .entry [idx$b_keylen];
3         IF .entry GTR .parent_block + lbr$c_pagesize    ! Don't loop forever if not found
3         THEN RETURN lbr$_intrnlerr;
2     END;
2 !
2 !       Update the key in the parent index.
2 !
2 IF .index_desc [idd$v_ascii]              ! If ASCII string keys.
2 THEN
3     BEGIN
3     IF .parent_entry [idx$b_keylen] EQL .last_entry [idx$b_keylen]
3     THEN        ! We're in luck, they are the same size
4         BEGIN
4         parent_entry [idx$b_keylen] = .last_entry [idx$b_keylen];
4         CH$MOVE(.last_entry [idx$b_keylen],      ! Copy ASCII key
4                 last_entry [idx$t_keyname],
4                 parent_entry [idx$t_keyname]);
4         END
3     ELSE        ! Remove old entry, compress, and enter new one.
4         BEGIN
4         LOCAL
4             parent_entry_siz;
4
4         parent_entry_siz = idx$c_rfaplsbyt + .parent_entry [ idx$b_keylen];
4         CH$MOVE( .parent_block + index$c_entries + .parent_block[index$w_used]
4                 - (.parent_entry + .parent_entry_siz),
4                 .parent_entry + .parent_entry_siz,
4                 .parent_entry );                   !compress to cover old entry
4         parent_block[index$w_used] = .parent_block[index$w_used] - .parent_entry_siz;
4         perform (add_index2 (.index, .vbn, .index_block) );
3         END;
3     END
2 ELSE
2     RETURN lbr$_intrnlerr;                ! reset_highest2 only for ASCII keys
2 !
2 !       Mark the parent index block modified.
2 !
2 mark_dirty(.index_block [index$l_parent]);
2 !
2 !       Reset the highest key in the parent's parent.
```

```
; 2286          3084  2 !        Must check that .parent_block is the address of block .index_block [index$l_parent]
; 2287          3085  2 !        since the last call to add_index2 may have resulted in a new parent.
; 2288          3086  2 !        If there is a new parent then it has already been reset.
; 2289          3087  2 !
; 2290          3088  3 BEGIN
; 2291          3089  3 LOCAL
; 2292          3090  3     blk_adr,
; 2293          3091  3     status;
; 2294          3092  3
; 2295          3093  3 perform ( find_index ( .index_block [index$l_parent], blk_adr) );
; 2296          3094  3 IF .blk_adr EQL .parent_block
; 2297          3095  3 THEN
; 2298          3096  4     BEGIN
; 2299          3097  4     status = reset_highest2(.index,.index_desc, .index_block [index$l_parent],.parent_block);
; 2300          3098  4     IF NOT .status THEN RETURN lbr$_intrnlerr;
; 2301          3099  3     END;
; 2302          3100  2 END;
; 2303          3101  2
; 2304          3102  2 RETURN true;
; 2305          3103  2
; 2306          3104  1 END;



                                    0FFC 00000 RESET_HIGHEST2:
                                                      .WORD    Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11                          ; 2971
                   5E          08  C2 00002           SUBL2    #8, SP                                                        ;
                   57     10   AC  D0 00005           MOVL     INDEX_BLOCK, R7                                               ; 3012
                          02   A7  D5 00009           TSTL     2(R7)                                                         ;
                               03  12 0000C           BNEQ     1$                                                            ;
                             00D2  31 0000E           BRW      11$                                                           ;
                   50     0C   A7  9E 00011 1$:       MOVAB    12(R7), NEXT_ENTRY                                            ; 3018
                   51          67  3C 00015 2$:       MOVZWL   (R7), R1                                                      ; 3019
                   51     0C A147  9E 00018           MOVAB    12(R1)[R7], R1                                                ;
                   51          50  D1 0001D           CMPL     NEXT_ENTRY, R1                                                ;
                               0E  18 00020           BGEQ     3$                                                            ;
                   52          50  D0 00022           MOVL     NEXT_ENTRY, LAST_ENTRY                                        ; 3021
                   51     06   A0  9A 00025           MOVZBL   6(NEXT_ENTRY), R1                                             ; 3022
                   50     07 A140  9E 00029           MOVAB    7(R1)[NEXT_ENTRY], NEXT_ENTRY                                 ;
                               E5  11 0002E           BRB      2$                                                            ; 3019
                   51          6E  9E 00030 3$:       MOVAB    PARENT_BLOCK, R1                                              ; 3027
                   50     02   A7  D0 00033           MOVL     2(R7), R0                                                     ;
                             FD21  30 00037           BSBW     FIND_INDEX                                                    ;
                   6F          50  E9 0003A           BLBC     STATUS, 8$                                                    ;
                   58          6E  D0 0003D           MOVL     PARENT_BLOCK, R8                                              ; 3031
                   50     0C   A8  9E 00040           MOVAB    12(R8), ENTRY                                                 ;
                   53   0200   C8  9E 00044           MOVAB    512(R8), R3                                                   ; 3045
             0C    AC          60  D1 00049 4$:       CMPL     (ENTRY), VBN                                                  ; 3037
                               05  12 0004D           BNEQ     5$                                                            ;
                   56          50  D0 0004F           MOVL     ENTRY, PARENT_ENTRY                                           ; 3040
                               10  11 00052           BRB      6$                                                            ; 3039
                   51     06   A0  9A 00054 5$:       MOVZBL   6(ENTRY), R1                                                  ; 3044
                   50     07 A140  9E 00058           MOVAB    7(R1)[ENTRY], ENTRY                                           ;
                   53          50  D1 0005D           CMPL     ENTRY, R3                                                     ; 3045
                               E7  15 00060           BLEQ     4$                                                            ;
```

```
                                    77  11 00062          BRB     10$                                              ; 3046
                    73         08   BC  E9 00064 6$:      BLBC    @INDEX_DESC, 10$                                 ; 3051
               06   A2         06   A6  91 00068          CMPB    6(PARENT_ENTRY), 6(LAST_ENTRY)                   ; 3054
                                    11  12 0006D          BNEQ    7$                                               ;
               06   A6         06   A2  90 0006F          MOVB    6(LAST_ENTRY), 6(PARENT_ENTRY)                   ; 3057
                    50         06   A2  9A 00074          MOVZBL  6(LAST_ENTRY), R0                                ; 3058
     07    A6  07   A2              50  28 00078          MOVC3   R0, 7(LAST_ENTRY), 7(PARENT_ENTRY)               ; 3060
                                    2F  11 0007E          BRB     9$                                               ; 3054
                    59         06   A6  9A 00080 7$:      MOVZBL  6(PARENT_ENTRY), PARENT_ENTRY_SIZ                ; 3067
                    59              07  C0 00084          ADDL2   #7, PARENT_ENTRY_SIZ                             ;
                    50              68  3C 00087          MOVZWL  (R8), R0                                         ; 3068
           51       58              50  C1 0008A          ADDL3   R0, R8, R1                                       ;
           50       56              59  C1 0008E          ADDL3   PARENT_ENTRY_SIZ, PARENT_ENTRY, R0               ; 3069
                    51              50  C2 00092          SUBL2   R0, R1                                           ;
                    51              0C  C0 00095          ADDL2   #12, R1                                          ;
           66       60              51  28 00098          MOVC3   R1, (R0), (PARENT_ENTRY)                         ; 3071
                    68              59  A2 0009C          SUBW2   PARENT_ENTRY_SIZ, (R8)                           ; 3072
                                    57  DD 0009F          PUSHL   R7                                               ; 3073
                               0C   AC  DD 000A1          PUSHL   VBN                                              ;
                               04   AC  DD 000A4          PUSHL   INDEX                                            ;
             FE6D   CF              03  FB 000A7          CALLS   #3, ADD_INDEX2                                   ;
                    37              50  E9 000AC 8$:      BLBC    STATUS, 12$                                      ;
                    50         02   A7  D0 000AF 9$:      MOVL    2(R7), R0                                        ; 3081
                                 0000V  30 000B3          BSBW    MARK_DIRTY                                       ;
                    51         04   AE  9E 000B6          MOVAB   BLK_ADR, R1                                      ; 3093
                    50         02   A7  D0 000BA          MOVL    2(R7), R0                                        ;
                                  FC9A  30 000BE          BSBW    FIND_INDEX                                       ;
                    22              50  E9 000C1          BLBC    STATUS, 12$                                      ;
                    58         04   AE  D1 000C4          CMPL    BLK_ADR, R8                                      ; 3094
                                    19  12 000C8          BNEQ    11$                                              ;
                                    58  DD 000CA          PUSHL   R8                                               ; 3097
                               02   A7  DD 000CC          PUSHL   2(R7)                                            ;
                    7E         04   AC  7D 000CF          MOVQ    INDEX, -(SP)                                     ;
             FF28   CF              04  FB 000D3          CALLS   #4, RESET_HIGHEST2                               ;
                    08              50  E8 000D8          BLBS    STATUS, 11$                                      ; 3098
                    50  00000000G   8F  D0 000DB 10$:     MOVL    #LBR$_INTRNLERR, R0                              ;
                                        04 000E2          RET                                                      ;
                    50              01  D0 000E3 11$:     MOVL    #1, R0                                           ; 3102
                                        04 000E6 12$:     RET                                                      ; 3104

; Routine Size:  231 bytes,    Routine Base:  $CODE$ + 0F34
; 2308        3105  1 %SBTTL  'check_lock';
; 2309        3106  1 GLOBAL ROUTINE check_lock : JSB_0 =
; 2310        3107  2 BEGIN
; 2311        3108  2
; 2312        3109  2 !---
; 2313        3110  2 !
; 2314        3111  2 !       Check if the index is locked from modification.
; 2315        3112  2 !
; 2316        3113  2 ! Inputs:
; 2317        3114  2 !
; 2318        3115  2 !       None
; 2319        3116  2 !
; 2320        3117  2 ! Outputs:
; 2321        3118  2 !
; 2322        3119  2 !       None
; 2323        3120  2 !
; 2324        3121  2 ! Routine value:
; 2325        3122  2 !
; 2326        3123  2 !       true            Ok to modify index
; 2327        3124  2 !       lbr$_updurtrav  Index is locked
; 2328        3125  2 !
; 2329        3126  2 !---
; 2330        3127  2
; 2331        3128  2 BIND
; 2332        3129  2     index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc        ! Name index descriptor for current
; 2333        3130  2                 + (.lbr$gl_control [lbr$l_curidx] - 1) * idd$c_length
; 2334        3131  2                                 : BBLOCK;
; 2335        3132  2
; 2336        3133  2 IF .index_desc [idd$v_locked]
; 2337        3134  2     THEN RETURN lbr$_updurtrav
; 2338        3135  2     ELSE RETURN true
; 2339        3136  2
; 2340        3137  1 END;                                                   ! Of check_lock


                        51      0000G  CF  D0 00000 CHECK_LOCK::
                                                            MOVL    LBR$GL_CONTROL, R1                              ; 3129
                        50         12  A1  D0 00005         MOVL    18(R1), R0                                      ; 3130
                        50         0A B140 7E 00009         MOVAQ   @10(R1)[R0], R0                                 ;
                        50       00BC  C0  9E 0000E         MOVAB   188(R0), R0                                     ;
              08        60         01  E1 00013             BBC     #1, (R0), 1$                                    ; 3133
                        50 00000000G  8F  D0 00017          MOVL    #LBR$_UPDURTRAV, R0                             ; 3135
                                       05 0001E             RSB                                                     ;
                        50            01  D0 0001F 1$:      MOVL    #1, R0                                          ;
                                       05 00022             RSB                                                     ; 3137

; Routine Size:  35 bytes,    Routine Base:  $CODE$ + 101B
; 2342          3138  1 %SBTTL  'mark_dirty';
; 2343          3139  1 GLOBAL ROUTINE mark_dirty (vbn) : JSB_1 =
; 2344          3140  1
; 2345          3141  1 !---
; 2346          3142  1 !
; 2347          3143  1 !       Mark an index block modified in memory so that
; 2348          3144  1 !       it gets written back to disk when the file is closed.
; 2349          3145  1 !
; 2350          3146  1 ! Inputs:
; 2351          3147  1 !
; 2352          3148  1 !       vbn = disk block number
; 2353          3149  1 !
; 2354          3150  1 ! Outputs:
; 2355          3151  1 !
; 2356          3152  1 !       None
; 2357          3153  1 !---
; 2358          3154  1
; 2359          3155  2 BEGIN
; 2360          3156  2
; 2361          3157  2 LOCAL
; 2362          3158  2     cache_entry: REF BBLOCK;
; 2363          3159  2
; 2364          3160  2 perform (lookup_cache (.vbn, cache_entry)); ! Lookup entry in cache
; 2365          3161  2
; 2366          3162  2 cache_entry [cache$v_dirty] = true;     ! Mark modified
; 2367          3163  2
; 2368          3164  2 RETURN true;
; 2369          3165  2
; 2370          3166  1 END;



                            5E          04  C2 00000 MARK_DIRTY::
                                                             SUBL2   #4, SP                                       ; 3139
                            51          6E  9E 00003         MOVAB   CACHE_ENTRY, R1                              ; 3160
                                     0000G  30 00006         BSBW    LOOKUP_CACHE                                 ;
                            0A          50  E9 00009         BLBC    STATUS, 1$                                   ;
                            50          6E  D0 0000C         MOVL    CACHE_ENTRY, R0                              ; 3162
                   0C       A0          01  88 0000F         BISB2   #1, 12(R0)                                   ;
                            50          01  D0 00013         MOVL    #1, R0                                       ; 3164
                            5E          04  C0 00016 1$:     ADDL2   #4, SP                                       ; 3166
                                            05 00019         RSB                                                  ;

; Routine Size:  26 bytes,    Routine Base:  $CODE$ + 103E


; 2371          3167  1
; 2372          3168  1 END
; 2373          3169  0 ELUDOM
;                                     PSECT SUMMARY
;
;       Name                        Bytes                        Attributes
;
;  $CODE$                               4184  NOVEC,NOWRT, RD , EXE,NOSHR, LCL, REL, CON,NOPIC,ALIGN(2)



;                                Library Statistics
;
;                                          -------- Symbols --------        Pages       Processing
;       File                               Total    Loaded   Percent        Mapped      Time
;
;  _$255$DUA28:[SYSLIB]STARLET.L32;1        9776        14         0          581        00:01.0




;                                     COMMAND QUALIFIERS

;       BLISS/CHECK=(FIELD,INITIAL,OPTIMIZE)/LIS=LIS$:INDEX/OBJ=OBJ$:INDEX MSRC$:INDEX/UPDATE=(ENH$:INDEX)

; Size:          4184 code + 0 data bytes
; Run Time:         01:25.6
; Elapsed Time:     02:52.4
; Lines/CPU Min:     2220
; Lexemes/CPU-Min: 22428
; Memory Used:  377 pages
; Compilation Complete
```

0198 AH-BT13A-SE
VAX/VMS V4.0

DIGITAL EQUIPMENT CORPORATION
CONFIDENTIAL AND PROPRIETARY

GETHELP
LIS

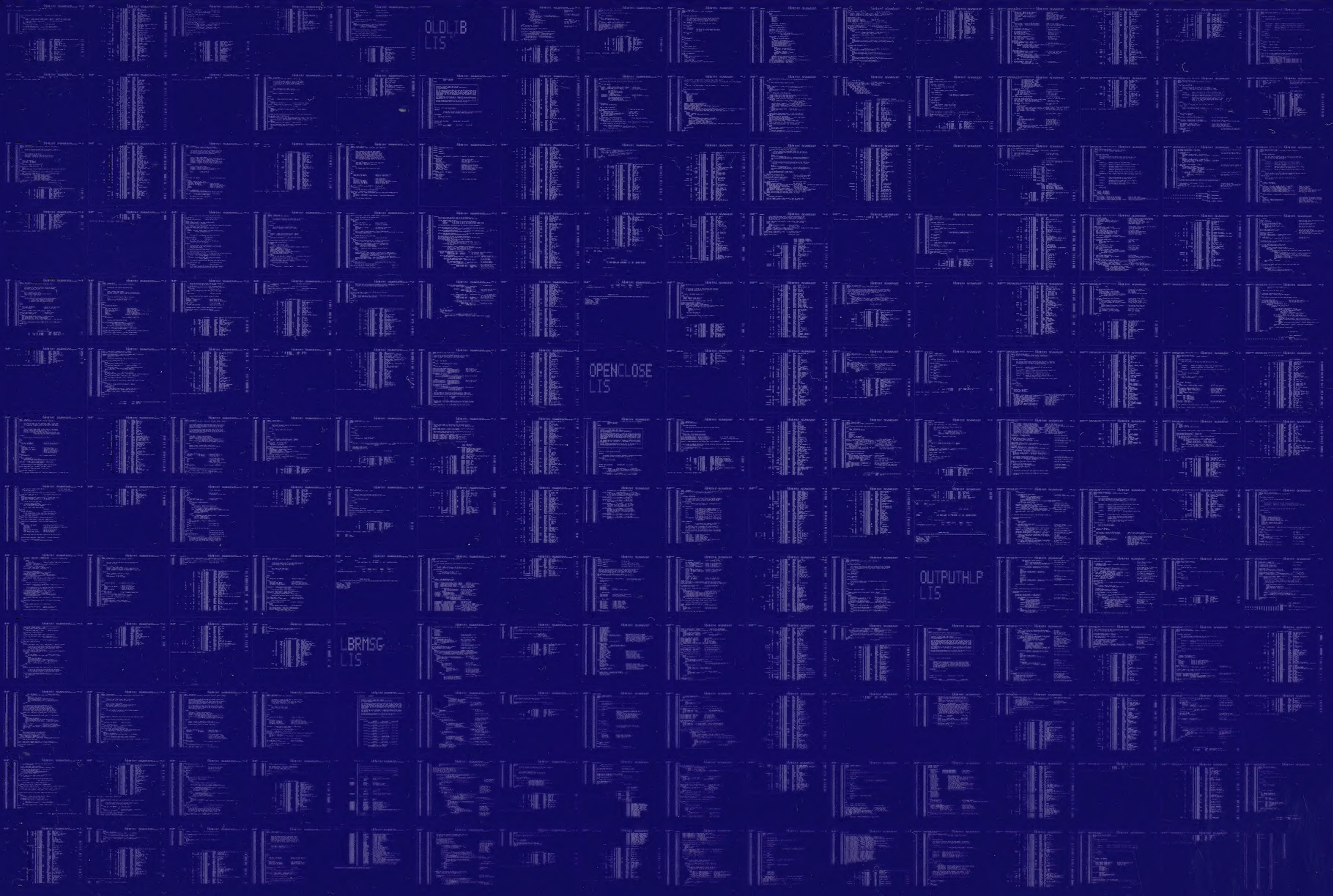
INDEX
LIS

GETPUT
LIS

GETMEM
LIS

0199 AH-BT13A-SE
VAX/VMS V4.0

DIGITAL EQUIPMENT CORPORATION
CONFIDENTIAL AND PROPRIETARY



OLDLIB
LIS

OPENCLOSE
LIS

OUTPUTHLP
LIS

LBRMSG
LIS